

# Comprehensive Agreement No. 1

## Third Annual Report

FY16

(July 1, 2015 – June 30, 2016)



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

Prepared by:



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**Comprehensive Agreement #1  
Prescott/Prescott Valley/SRP  
Monitoring/Modeling Committee  
FY16 Annual Report  
(July 1, 2015 – June 30, 2016)**

## **Introduction**

This is the third annual report describing the progress of the Monitoring and Modeling Committees (Committees) established by Comprehensive Agreement #1 (CA#1). Since late 2012, the Committees have worked toward implementing the Data Collection and Monitoring Plan (DCMP) attached to CA#1, including 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 document contains the background for the overall project, accomplishments during Fiscal Year 2016 (FY16), financial records, and the ongoing water monitoring and groundwater modeling efforts required to fully execute the CA#1 objectives.

## **Background**

In a joint meeting of the City of Prescott and the Town of Prescott Valley on September 19, 2012, their Councils 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 Committee
- Informal Conference Call on 2/27/16 to resolve pressing issues
- Multi-agency meeting (8/26/2015)

### *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) (6/18/ 2016)
- Coordinated with Yavapai County Flood Control District (YCFCD) to install and maintain a weather station in Limestone Canyon (11/23/2015)
- Developed Scope of Work and executed contract with Southwest Groundwater Consultants to assess and/or design long-term monitoring wells for the Big Chino Sub-basin Data Collection and Monitoring Plan (6/7/2016)
- Developed draft work plan to collect and analyze geochemical data with USGS to be executed in Fiscal Year 2017 (FY17)
- Attempted to resolve land access issues for hydrologic monitoring on the Yavapai Ranch. Agreement between Committee and Landowner was not reached.
- Established preliminary access agreement with Civitan Foundation for investigating condition of paired “Headwaters Wells” for hydrologic monitoring purposes
- Established access agreements with two landowners for installing Flowtophography equipment at Sullivan Dam

- Established access agreement with US Forest Service – Prescott National Forest for installation of Flowtography/weather monitoring equipment at George Wood Canyon
- Developed Request for Statements of Qualification for Groundwater Modeling

#### *Funding Contributions*

- All parties made monetary contributions for the Monitoring and Modeling Plan for FY16 per CA#1

#### *Public Information*

- Presentations
  - 2015 Verde River Monitoring Summit - Munderloh (11/5/2015)
  - Town of Prescott Valley Council Update – Munderloh (6/16/2016)
- City of Prescott website – continual updates

#### *. Status Reports Completed*

- Big Chino Sub-basin Water Monitoring Project, Monsoon Season Report, July 1 – September 30, 2015.  
[www.prescott-az.gov/d/bcwr\\_seasonal\\_reports\\_winter\\_spring.pdf](http://www.prescott-az.gov/d/bcwr_seasonal_reports_winter_spring.pdf)
- Big Chino Sub-basin Water Monitoring Project, July 1, 2015 – June 30, 2016 Annual Report. See Appendix I

## **Accounting/Budget**

In accordance with CA#1, the Parties fund the project with annual contributions. The City of Prescott is the fiduciary. The budget for the period of this annual report (FY16) is shown in **Table 1** as Year 3. 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 30<sup>th</sup> timeframe. Further, SRP adjusted their contributions to increase their contributions in the early years of the project; their overall project contributions total was unchanged.

A detail of expenditures for FY16 only, is shown in **Table 2**. Since the CA#1 commenced, the monitoring project account balance and expenditures as of June 30, 2016, are \$2,630,307.58 and \$685,302.41, respectively. Similarly, the modeling project account balance and expenditure as of June 30, 2016, are \$709,680.00 and zero, respectively. The overall project funds have encumbrances with ongoing contracts, but those encumbrances are not reflected in the values shown above. In early to mid-calendar year 2017 it is expected that a modeling contract will be executed and monitoring well drilling contract(s) will be underway. The accumulation of funds in these

accounts anticipates the large project costs for the modeling contract and for drilling several monitoring wells.

**Table 1 – Contract Budget in FY 16**

(Including monitoring contributions for WAC equipment)

Entity	Year 3 Contributions			Year 2 Contributions <sup>1</sup>		
	Monitoring	Modeling	WAC equipment <sup>2</sup>	Monitoring	Modeling	WAC equipment <sup>2</sup>
Prescott	483,913	99,578	22,061	256,359	156,380	22,061
Prescott Valley	410,566	84,485	21,496	217,502	132,677	21,496
SRP	369,636	92,031	0	286,931	144,529	0

<sup>1</sup> Per contract, Exhibit 5, the parties began funding the modeling portion of the project.

<sup>2</sup> Prescott and Prescott Valley were members of the former Yavapai County Water Advisory Committee (WAC) which had contracted with USGS for monitoring activities and equipment maintenance in the Big Chino Sub-basin. After verifying its continued importance to the CA#1 monitoring program Prescott and Prescott Valley agreed to continue paying for this program by supplanting WAC membership dues. Prescott and Prescott Valley assumed the full costs in Year 2 and Year 3 of the CA#1 program, after which the “WAC” monitoring will become part of the CA#1 monitoring program and the costs will be paid by all parties.

**Table 2 – Contract Expenditures in FY16**

Description	Amount	Payment Date(s)
New Stream Gages	\$120,853.23	9/17/15, 12/7/15, 6/13/2016,12/17/16,3/21/16,6/22/16
Existing Stream Gage	\$9,628.95	9/17/15, 3/21/16
Exiting Well Monitoring	\$3,412.95	9/17/15,3/21/16, 6/22/16
USGS Services	\$227,130.00	7/1/15, 5/2/16
<b>Total</b>	<b>\$361,025.13</b>	

## Monitoring Project - Equipment

CA#1 was executed with the knowledge of existing monitoring in the sub-basin in conjunction with the requirement for new equipment installation for groundwater modeling purposes. Although not all data collection to date is reflected in this annual report, new equipment 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**
- During FY16 no new sites were added to the network.
- Water level changes in B-18-04 01ACA2 (BMW-3) and B-18-01 17AAA (Gipe) hydrographs were noted.
- On 6/7/2016, the Parties executed a scope of work with Southwest Groundwater Consultants to complete a groundwater well assessment. The reference document is City Contract No. 2016-296. The contract is ongoing and will be documented in the FY17 annual report.

### Stream flow Monitoring

- See **Appendix III, Maps 3-5**
- On 5/25/2016, SRP installed a Flowtography camera on the Old Highway 89 bridge over the Verde River to monitor flows at Sullivan Dam. Installation of a staff gage on Sullivan Dam itself required permission from a separate landowner. Efforts continued to seek landowner permission to install a staff gage. Permission for the staff gage was granted on 07/12/2016 and completion is scheduled before the end of the calendar year 2016.

### Weather Monitoring

- See **Appendix III, Maps 6 and 6a**
- On 11/23/2015, at the request of the Committee, YCFD installed a precipitation gage in the location of Big Black Mesa at Limestone Canyon, "Limestone Canyon". YCFD did not charge the Committee for the capital cost and will not charge for the long-term operations and maintenance cost because this weather station also meets the objectives for their flood-warning system.

- On 12/9/2015, SRP installed a gage to record Wind, Precipitation, Snow Depth, Barometric Pressure, Relative humidity, and Temperature in the location of George Wood Canyon, “George Wood Canyon”.
- FY16 precipitation graphs for all weather station sites can be found on **Map 6a**

#### Aquifer Storage Monitoring and Geophysical Surveys

During FY16 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 2 wells, conducted aquifer-storage monitoring (aka “gravity surveys”) at 25 sites, and conducted geophysical surveys in Area 1 (east of Hwy 89 and Paulden).

- See **Appendix III, Map 7** for gravity sites and **Map 8** for Geophysical profiles.
- 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 sampling of groundwater from wells and springs for stable isotopes and noble gases. The purpose of the 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 each year with the long-term goal of developing geochemical signatures of groundwater throughout the Big Chino hydrogeologic system. Two wells were sampled for stable isotopes, noble gases, and other standard geochemical parameters during the subject period. USGS also developed a more comprehensive geochemical work plan for the Parties consideration.
- Aquifer-storage monitoring of 26 stations was completed on a seasonal basis including absolute gravity surveys in October 2015, February 2016, and May 2016. A total of 72 absolute gravity observations were made at 25 of 26 stations. One station was not observed because it is particularly sensitive to weather conditions and existing conditions did not permit an observation.
- Depth to water was also observed at gravity stations that are co-located at wells. Depths to water are observed by USGS at 12 wells coincident with gravity observations and entered into the GWSI database. Continuous depth to water is also recorded at 4 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 are

collected at 6 gravity stations because there is no co-located well or the well is inaccessible for measurements.

- Trends in aquifer storage are evident from gravity observations at 9 stations that have records longer than 2 years. Increases in storage during 2012-2016 are evident at only one station. Persistent decreasing storage trends during 2009-2016 are evident at 2 stations. Other stations display variable storage trend records or no significant variations during the period of record. Most stations were established in 2015, have short records, and display no significant trends.
- Geophysical surveys included Controlled-Source Audio-Magneto Telluric (CSAMT) surveys of the area designated Area 1, which lies east of Paulden. A total of 26.6 kilometers of survey lines were completed for the year. These surveys, along with 5.9 kilometers of surveys completed in the previous year, nearly complete the proposed surveys in Area 1. Completed surveys include 3 east-west profiles and 4 north-south profiles across the region of proposed drilling of Area 1. One north-south profile, the western most profile, is scheduled for additional measurements to the south, which will complete surveys in Area 1 if no other surveys are determined to be needed in the area. Preliminary subsurface electrical models of the CSAMT data have also been completed.

#### Crop Surveys and Estimated Crop Water Use

The USGS, in contract with ADWR, conducted crop surveys in the Big Chino Sub-basin in June 2015. The results are shown in **Table 3**, and depicted in **Appendix III, Maps 9-1 to 9-4**.

Approximately 68% of the irrigable lands that were surveyed were being cropped in 2015 (1448.65 acres in June). The USGS estimated that the total water withdrawal for crops on these lands was 2811.62 acre-feet during summer 2015. This represents a total withdrawal of 1.9 acre-feet per 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.

It is anticipated that this effort will continue as structured; however, the CA#1 Parties recognize that the ADWR seeks to have this type of survey completed in various groundwater basins across the state. If focus changes away from the Big



Chino Sub-basin in the future, the Parties will discuss methods for maintaining this data collection.

**Table 3– 2016 Crop Survey – Acres Irrigated June 2015**

Crop	Map Area				Total
	Upper Big Chino	Paulden	Williamson Valley	Walnut Creek	
ALFALFA	145.41			8.16	153.57
BARLEY/ WHEAT	179.28	19.53			198.81
CORN	83.32				83.32
GRASS		116.40	74.53	594.64	785.57
OATS				15.51	15.51
SOD		91.82			91.82
TIMOTHY GRASS	120.05				120.05
<b>Total Crop Acres</b>	<b>528.06</b>	<b>227.75</b>	<b>74.53</b>	<b>618.32</b>	<b>1448.65</b>
<b>No Crop Evident</b>	<b>1325.44</b>	<b>164.99</b>	<b>158.19</b>	<b>465.52</b>	<b>2117.14</b>

## Monitoring Project - Analytical Results and Data Collected

The results of the data collection efforts are being reported by the identified agencies within data specific reporting formats. One of the duties of the CA#1 Monitoring Committee is to coordinate and monitor these 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) near the end of the contract period (estimated summer 2017). 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 projects that their next water level sweep of the Big Chino Sub-basin will occur in 2017; the last sweep occurred in 2009. ADWR maintains this information in the Groundwater Site Index (GWSI) data base that is hosted on-line at [www.azwater.gov](http://www.azwater.gov).

### *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 and flow stage data is collected by YCFCD for flood control purposes.

- Efforts by SRP

SRP Field Services Division collects stream flow data and other information at thirteen (13) locations in the Big Chino Sub-basin under contract with the CA#1 program. A seasonal report and an annual report were completed during FY16 to document the results of the flow monitoring program. The seasonal report has been posted to the City’s Big Chino website, and the annual report is attached to this document as **Appendix I**. The annual hydrographs combining stream flows from both reports are located in **Appendix III, Maps 3 and 4**.

- 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 CA#1 contract, Exhibit 5, identifies the commencement of model funding, conceptual planning, and aquifer storage and geophysics work in FY16. The aquifer storage and geophysics work was initiated earlier in the CA#1 program than initially anticipated (City Contract No. 2014-160/USGS Agreement No. 14WSAZ03400, March 2014) because the Parties and support agencies understood the value of geophysics data to inform the monitor well drilling and as an additional data set to improve the groundwater model. The groundwater model funding was detailed earlier in this document. During FY16, the Parties engaged in monthly meeting to prepare a Request for Statements of Qualification (RSOQ) for the Big Chino Sub-basin Groundwater Flow Model. The public notice for the RSOQ was placed in three (3) newspapers on 7/24/16, 7/31/16, and 8/7/16. Progress on the model will be included in the FY17 (July 1, 2016 to June 30, 2017) CA#1 annual report. For a link to the RSOQ, see the City's website at <http://www.prescott-az.gov/services/water/chino.php>

## **Conclusions**

The FY16 project year has been very active in two respects, 1) continued on-the-ground data collection with some additional equipment placement; and 2) document preparation and review to initiate additional scientific contracts as outlined in CA#1.

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 geophysical profiles have extensive additional work to complete

due to the large land areas and land access requirements. The crop survey work in the sub-basin will continue per the joint funding agreement between the USGS and ADWR.

For FY17, the current fiscal year, the focus will be to enter into two (2) new contracts: one for the groundwater flow modeling and another for geochemistry. The Committee will also prepare a scope of work for new monitor wells based upon the results from the current contract with Southwest Groundwater Consultants. This will occur while continuing the work associated with all the existing contracts. The modeling contract will be the most labor intensive in the next few years along with drilling new monitoring wells.

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 be increasing in FY17 as the modeling contract is developed and executed.

*APPENDIX I*

*Big Chino Sub-basin Water Monitoring  
Project,  
July 1, 2015 – June 30, 2016  
Annual Report*



Sullivan Dam SRP Flowtography® monitoring equipment, installed 5/25/2016

# Big Chino Sub-basin Water Monitoring Project

July 1, 2015 – June 30, 2016 Annual Report

Prepared for CA1 Monitoring Committee  
(Prescott, Prescott Valley, SRP)

Prepared by Alanna Mecsey, Hydrographic Analyst for SRP Water Measurement  
9/7/2016

## Table of Contents

<b>Introduction</b> .....	2
<b>Background and Rating Development</b> .....	2
<b>Site Maintenance and Data Processing</b> .....	3
<b>Seasonal Flow Events Summary</b> .....	3
<b>Location Summaries</b> .....	7
<b>Upper Big Chino Wash (UBCW)</b> .....	7
<b>Big Chino Wash below Partridge Creek (BCWPC)</b> .....	9
<b>Partridge Creek</b> .....	11
<b>Big Chino Wash at Prescott Ranch (BCWPR)</b> .....	12
<b>Pine Creek (PC)</b> .....	13
<b>George Wood Canyon (GWC)</b> .....	15
<b>Upper Walnut Creek at Forest Service (UWCFS)</b> .....	19
<b>Upper Walnut Creek at Bridge (UWCB)</b> .....	21
<b>Lower Walnut Creek at Charney Property (LWCCP)</b> .....	22
<b>Williamson Valley Wash at XU Ranch (WVWXU)</b> .....	23
<b>Lower Williamson Valley Wash (LWVW)</b> .....	25
<b>Lower Big Chino Wash (LBCW)</b> .....	27
<b>Sullivan Dam (SD)</b> .....	29
<b>Verde Headwaters at Campbell Ranch (VHCR)</b> .....	30
<b>Gipe Well (GW)</b> .....	31
<b>Additional Activities and Observations</b> .....	31
<b>Maintenance and Equipment Modifications</b> .....	32
<b>Snow Accumulation Observations</b> .....	33
<b>Things to Come</b> .....	34
<b>Conclusions</b> .....	34

## Introduction

The purpose of the Big Chino Sub-Basin Ephemeral Stream Flow Monitoring Project is to collect additional surface water hydrologic data for use in the development of a numerical groundwater flow model within the Big Chino Sub-basin. This annual report is being 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). The following reports have come before this annual report: July 2014-September 2014 Monsoon Report, October 2014-June 2015 Winter/Spring Report, and the July 2015-September 2015 Monsoon Report.

Under an independent contractor’s agreement approved in 2013, SRP Water Measurement (WM) was selected to provide the installation, maintenance, and data collection at nine initial stream-flow sites within the Big Chino Sub-basin, and one additional weather station and two additional camera only SRP Flowtography® sites. A summary of flow events recorded during the 2015-2016 season (July 1, 2015 to June 30, 2016) is contained within this report.

## Background and Rating Development

As part of this monitoring effort, SRP Flowtography® equipped stream-flow monitoring locations were installed between December 2013 and June 2014. SRP Flowtography® is a system of hardware combined with data processing that improves knowledge of the hydrologic conditions and site operation. The system utilizes time-lapse high resolution photography of a stationary event gage within the frame of the image to capture real time images of conditions. Standard configuration at most monitoring locations include upstream and downstream event gages equipped with pressure transducers (to collect stage values) and a SRP Flowtography® camera mounted on the stream bank that records images of the upstream event gage. Channel surveys were conducted to determine the cross sections for event gages at each monitoring location. Using the Slope-Area Method and preliminary survey data collected in the field, an illustrative detailed estimate of flow prediction was calculated for channel stages. The collected survey information was analyzed through Hec-Ras modeling software to develop a rating table, a rating curve and a rating equation for the upstream and downstream cross sections.

Table 1 outlines the most recent surveys at each SRP Flowtography® location and the dates of rating changes.

*Table 1: Big Chino Sub-basin Site Survey and Rating Curve Effective Dates by Site*

	Upper Big Chino Wash	Big Chino Wash below Partridge Creek	Pine Creek	Upper Walnut Creek at Forest Service	Lower Walnut Creek at Charney Property	Williamson Valley Wash at XU Ranch	Lower Williamson Valley Wash	Lower Big Chino Wash
<b>Most Recent Survey Date</b>	5/11/16	5/11/16	1/11/16	3/27/15	5/25/16	4/27/16	3/15/16	3/15/16
<b>Current Rating Effective Date</b>	8/1/16	6/22/16	6/30/16	1/8/15	6/28/16	7/19/16	6/29/16	6/27/16



## Site Maintenance and Data Processing

Routine and non-routine site maintenance was completed in July 2015 through June 2016. Routine maintenance included collection of upstream and downstream transducer data, collection of SRP Flowtography® images from cameras, general cleaning of each site, and verification of general site operation. Several non-routine servicing (break-fix events) were also required and included replacing pressure transducer housings and event gages, addition of image loss prevention equipment and a secondary camera, upgrade of the primary cameras, addition of lithium batteries, troubleshooting camera issues, and additional site investigation/surveying required for data processing. Specifics on site visits for each location are discussed in the Location Summaries section.

Data processing of stage values and rating curves were completed using Aquarius (version 3.5) time series software. Stage values (feet) collected from the upstream transducer serve as the primary data source (downstream transducer serve as secondary). Offsets to stage values were applied based on the depth of the transducer below the stream channel and then compared with the visual determination of stage values from SRP Flowtography® images. For instances when the event gage was obstructed or missing from the SRP Flowtography® images, stage level overlays were created using a tag line reference at each location (see Figure 1 and Figure 2).

Figure 1. Upper Big Chino Wash tagline reference.

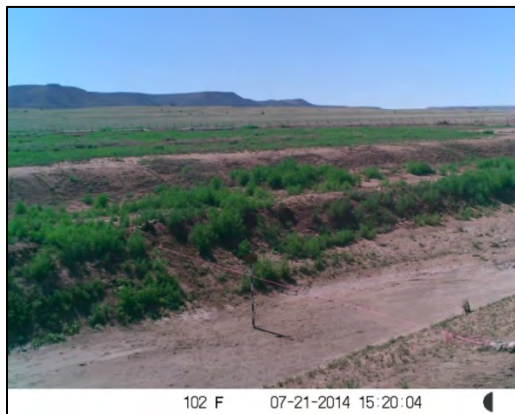
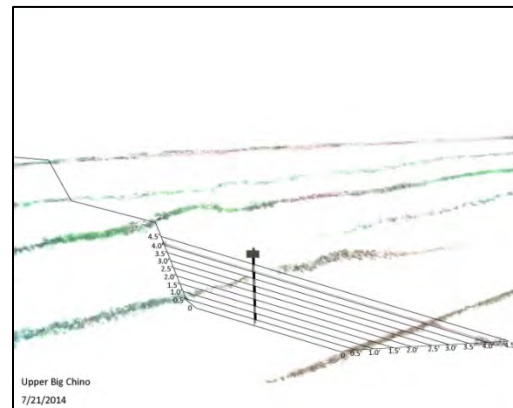


Figure 2. Upper Big Chino Wash stage level overlay.



The developed ratings were used to generate discharge values in cubic-feet per second (CFS) for each stage value. The hourly average CFS was used to calculate the total volume of water in acre-feet (AF) for each flow event.

Two additional gages located in the Big Chino Sub-basin are also briefly discussed in this report. The Gipe Well (GW) is serviced and data is collected quarterly. The other gage is located approximately 3 miles downstream of Sullivan Dam on the Verde River. The Verde Headwaters at Campbell Ranch (VHCR), measures low flows. Both sites were installed by SRP and are monitored now by the CA1 Monitoring Committee.

## Seasonal Flow Events Summary

During the July 2015 through June 2016 annual reporting period, a total of 22 days were observed with surface water flowing at one or more locations. The number of locations with flow, magnitude of flow, and duration of flow during these events varied throughout the sub-basin (See Table 2 and Figure 3).

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

- The most widespread flow occurred early in the reporting period on July 19, 2015. On that day four of seven locations indicated at least some surface water discharge.
- The largest flow event was observed at Pine Creek on September 22, 2015. The total discharge for that one day was 230 AF.
- Twelve (12), the highest number of events, occurred at Upper Big Chino Wash.
- Zero (0), the fewest number of events, occurred at Lower Walnut Creek at Charney Property.
- The longest lasting event, spanning more than fifteen (15) days, occurred at Williamson Valley Wash at XU Ranch starting on January 31, 2016.

The July 2015 through June 2016 annual flow event totals in acre-feet (AF) at each location are outlined in Table 2 and Figure 3.

Table 2. Big Chino Sub-basin July 1, 2015 – June 30, 2016 Flow Event Totals in acre-feet (AF)

Start Date*	Upper Big Chino Wash (UBCW)	Big Chino Wash below Partridge Creek (BCWPC) **	Partridge Creek***	Pine Creek (PC)	Upper Walnut Creek at Forest Service (UWCFS)****	Upper Walnut Creek at Bridge (UWCB) (yes/no to flow)	Lower Walnut Creek at Charney Property (LWCCP)	Williamson Valley Wash at XU Ranch (WVWXU)	Lower Williamson Valley Wash (LWVW)	Lower Big Chino Wash (LBCW)
7/1/15	0	0	0	0	low	No visible flow	0	0	0	0
7/3/15	0	0	0	0.2	low	No visible flow	0	0	0	0
7/6/15	7	0	0	23	low	No visible flow	0	0.6	0	0
7/18/15	0.2	0	0	3	low	No visible flow	0	0	73	0
7/19/15	0.3	101	100.7	0	low	No visible flow	0	0	6	9
8/5/15	0	0	0	0	0	No visible flow	0	0	25	0
8/11/15	4	7	3	0.1	0	No visible flow	0	0	0	0
8/12/15	0.2	0	0	4	0	No visible flow	0	0	0	0
8/26/15	6	54	48	0	0	No visible flow	0	0	0	0
8/30/15	0.4	0	0	0	0	No visible flow	0	0	0	0
9/6/15	0	0	0	4	0	No visible flow	0	0	0	0
9/10/15	0.8	6	5.2	78	0	No visible flow	0	0	0	0
9/14/15	0.6	0	0	0	0	No visible flow	0	0	0	0
9/22/15	0	0	0	230	0	No visible flow	0	0	0	0
10/7/15	0	0	0	0	0	No visible flow	0	0	0	0
10/16/15	0.6	0	0	0	high	No visible flow	0	0	0	0
10/17/15	0	0	0	0	high	No visible flow	0	22	0	0
10/18/15	3	0	0	0	high	Visible flow	0	28	0	0
11/6/15	0	0	0	0	high	Visible flow	0	0	0	0
1/6/16	0	0	0	0	low	No visible flow	0	12	0	0
1/31/16	0	0	0	0	high	Visible flow	0	36	0	0
4/30/16	7	0	0	0	low	No visible flow	0	0	0	0
<b>Totals</b>	<b>30.1</b>	<b>168</b>	<b>156.9</b>	<b>342.3</b>			<b>0</b>	<b>98.6</b>	<b>104</b>	<b>9</b>

\*Note: Flow events may start just prior to date indicated or continue into following day.

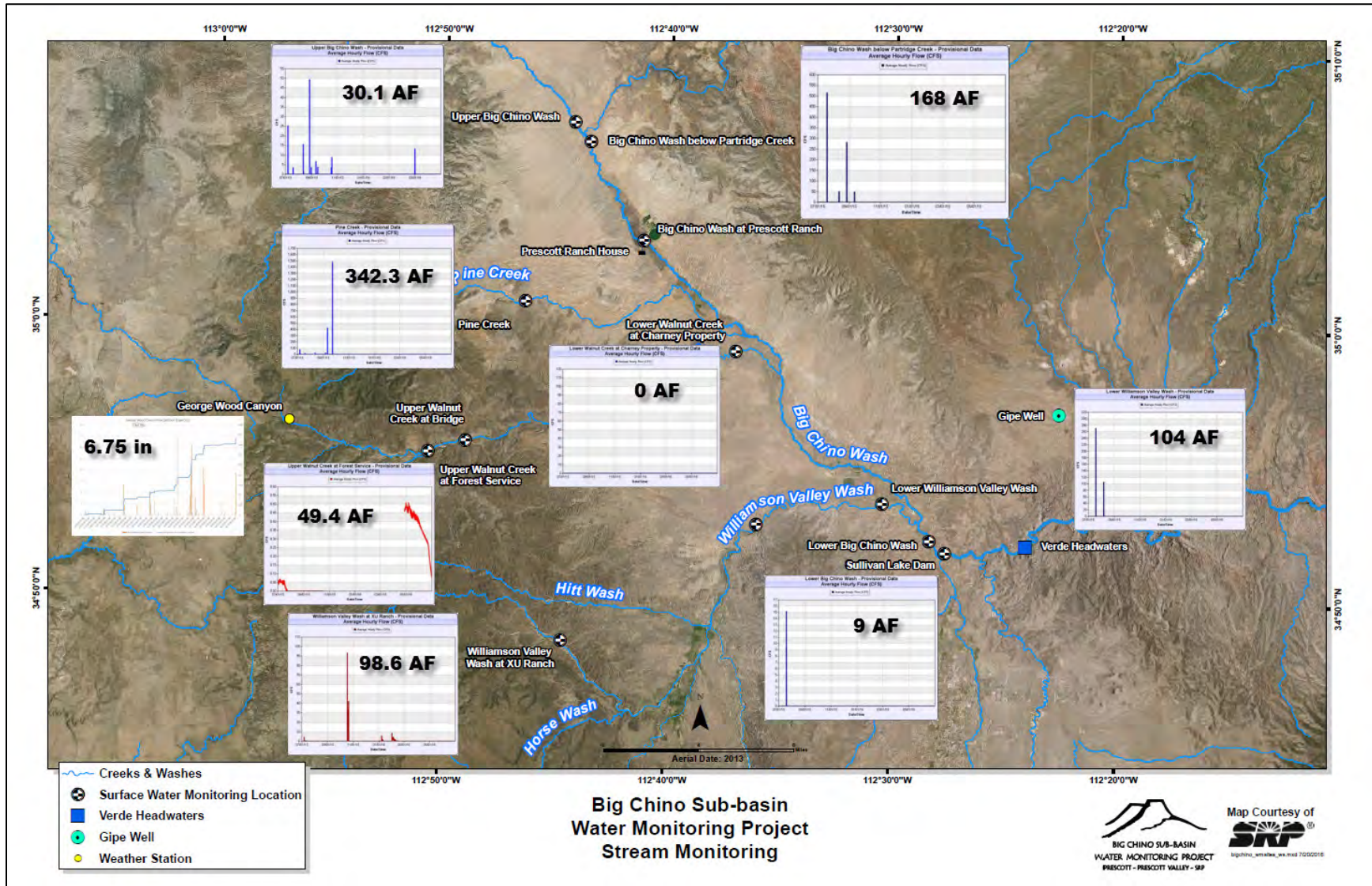
\*\* Upper Big Chino Wash flows may be included in these numbers.

\*\*\*These flows were derived by subtracting the Upper Big Chino Wash contribution from the flows at Big Chino Wash below Partridge Creek. These are estimated flows, as there is no monitoring equipment on Partridge Creek.

\*\*\*\*Surface water flow is observed throughout the year at the Upper Walnut Creek at Forest Service flume. During some low and high flow events, the water was running through and around the flume and unmeasured. Terms “low” and “high” were used as subjective indications of the flow based on visual observations. See Figure 13 on page 19 for low and high flow event images. Flows marked as ‘0’ are when there was no flow observed at the site.

Note: The previously reported monsoon period (July 2015 – September 2015) is included in this table. The most recent unreported period of the winter 2015 - spring 2016 is highlighted **blue**. This color designation will be continued throughout the document.

Figure 3. Big Chino Sub-basin July 1, 2015 – June 30, 2016 SRP Flowtography® Stream-flow Monitoring Location Hydrographs with Total Estimated Water Volumes in acre-feet (AF)



## Location Summaries

### Upper Big Chino Wash (UBCW)

Twelve (12) flow events were recorded at Upper Big Chino Wash (UBCW) during the period from July 1, 2015 through June 30, 2016. Peak discharge during the flow events ranged from 4 CFS on 8/12/2015 to 90 CFS on 8/26/2015. Total volume of each event ranged from <1 AF to 7 AF, with 7 AF occurring on July 6, 2015 and April 30, 2016 (Table 3 and Figure 4). A total volume of 30.1 AF was estimated to flow through the UBCW location during the 2015-2016 annual reporting period. Individual events ranged in duration from 2 to 11 hours, with a total duration of 61 hours.

Table 3: Upper Big Chino Wash July 2015 - June 2016 Annual Flow Events

Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/6/2015	14:15	11	0.95	25	7
7/18/2015	17:30	2	0.35	7	0.2
7/19/2015	00:15	2	0.45	9	0.3
8/11/2015	11:30	9	1.00	30	4
8/12/2015	06:30	2	0.25	4	0.2
8/26/2015	13:15	5	1.90	90	6
8/30/2015	11:45	2	0.45	9	0.4
9/10/2015	15:45	3	0.85	23	0.8
9/14/2015	21:45	2	0.60	14	0.6
10/16/2015	17:00	7	0.25	4	0.6
10/18/2015	0:00	9	0.47	9	3
4/30/2016	21:16	7	0.60	13	7
<b>Totals</b>		<b>61</b>	<b>1.90</b>	<b>90</b>	<b>30.1</b>

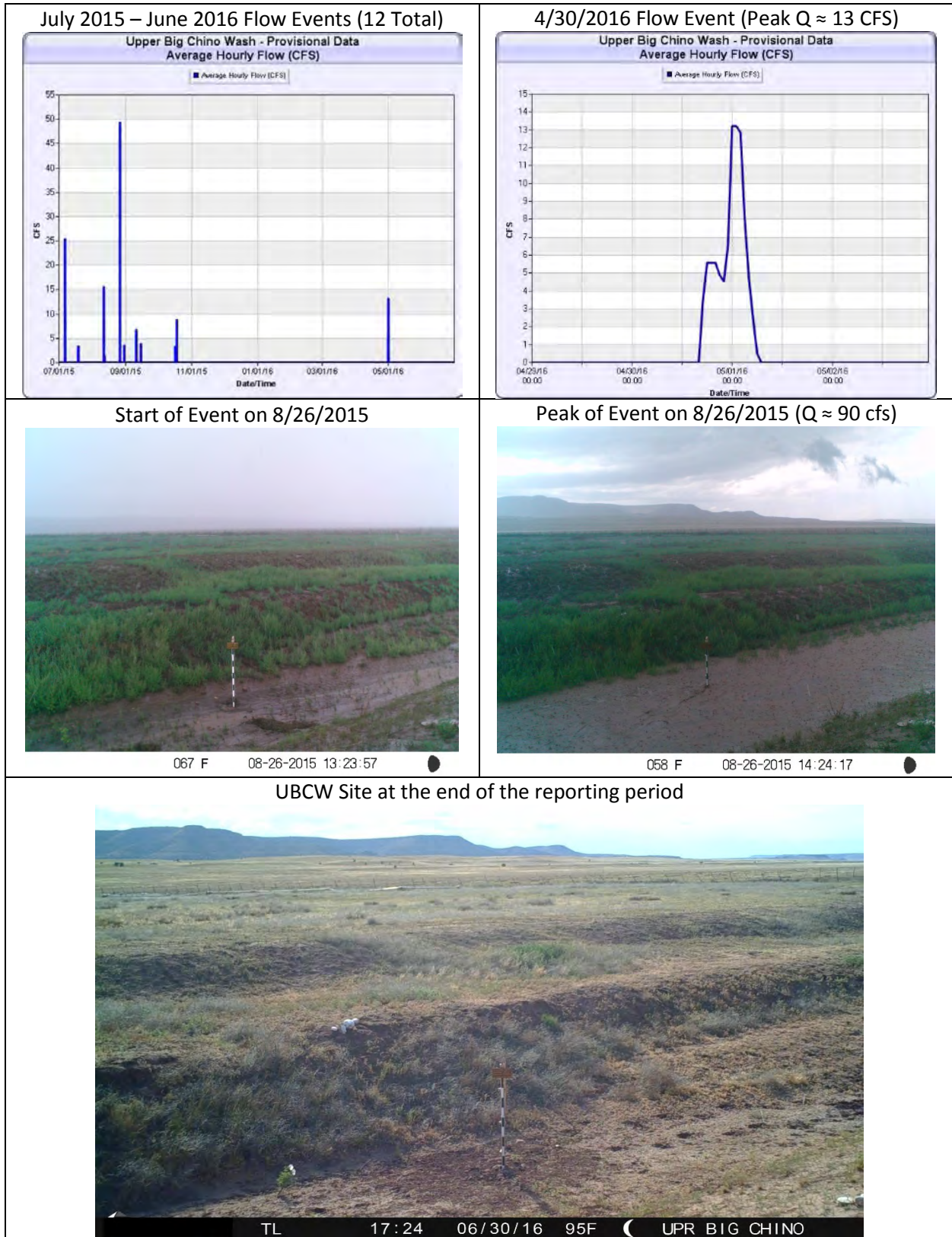
\*Start times are approximate within 15 minutes and events may continue into the following days.

Note: The previously reported monsoon period (July 2015 – September 2015) is included in this table. The most recent unreported period of the winter 2015 - spring 2016 is highlighted **blue**.

The UBCW location was visited a total of seven (7) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for the monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Site connectivity repairs.
- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of new pressure transducer housings at the upstream and downstream event gages.
- Installation of image loss prevention equipment, lithium batteries, and a secondary camera
- Resurvey of the stream channel.

Figure 4: Upper Big Chino Wash Hydrographs and SRP Flowtography® Flow Event Images



## Big Chino Wash below Partridge Creek (BCWPC)

Four (4) flow events were recorded at Big Chino Wash below Partridge Creek (BCWPC) during the period from July 1, 2015 through June 30, 2016. All flow events occurred during the previously reported monsoon period. Peak discharge during the flow events ranged from 58 CFS on August 11, 2015 to 800 CFS on July 19, 2015. Total volume of each event ranged from 6 AF to 101 AF, with 101 AF occurring on July 19, 2015 (Table 4 and Figure 5). A total volume of 168 AF was estimated to flow through the BCWPC location during the 2015-2016 annual reporting period. Individual events ranged in duration from 4 to 8 hours, with a total duration of 21 hours.

The upstream and downstream event gages were damaged during the flow event on July 19, 2015. They were straightened out on August 14, 2015 and replaced with new event gages on August 26, 2015. A flow event on the evening of the 26<sup>th</sup> damaged the event gage. The flow events for the period from July 19, 2015 through October 7, 2015 were estimated using SRP Flowtography® image data.

Table 4: Big Chino Wash below Partridge Creek July 2015 - June 2016 Annual Flow Events

Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/19/2015	02:00	8	6.15	800	101
8/11/2015	14:30	4	2.25	58	7
8/26/2015	14:30	5	4.50	350	54
9/10/2015	16:00	4	2.50	80	6
<b>Totals**</b>		<b>21</b>	<b>6.15</b>	<b>800</b>	<b>168</b>

\*Start times are approximate within 15 minutes and events may continue into the following days.

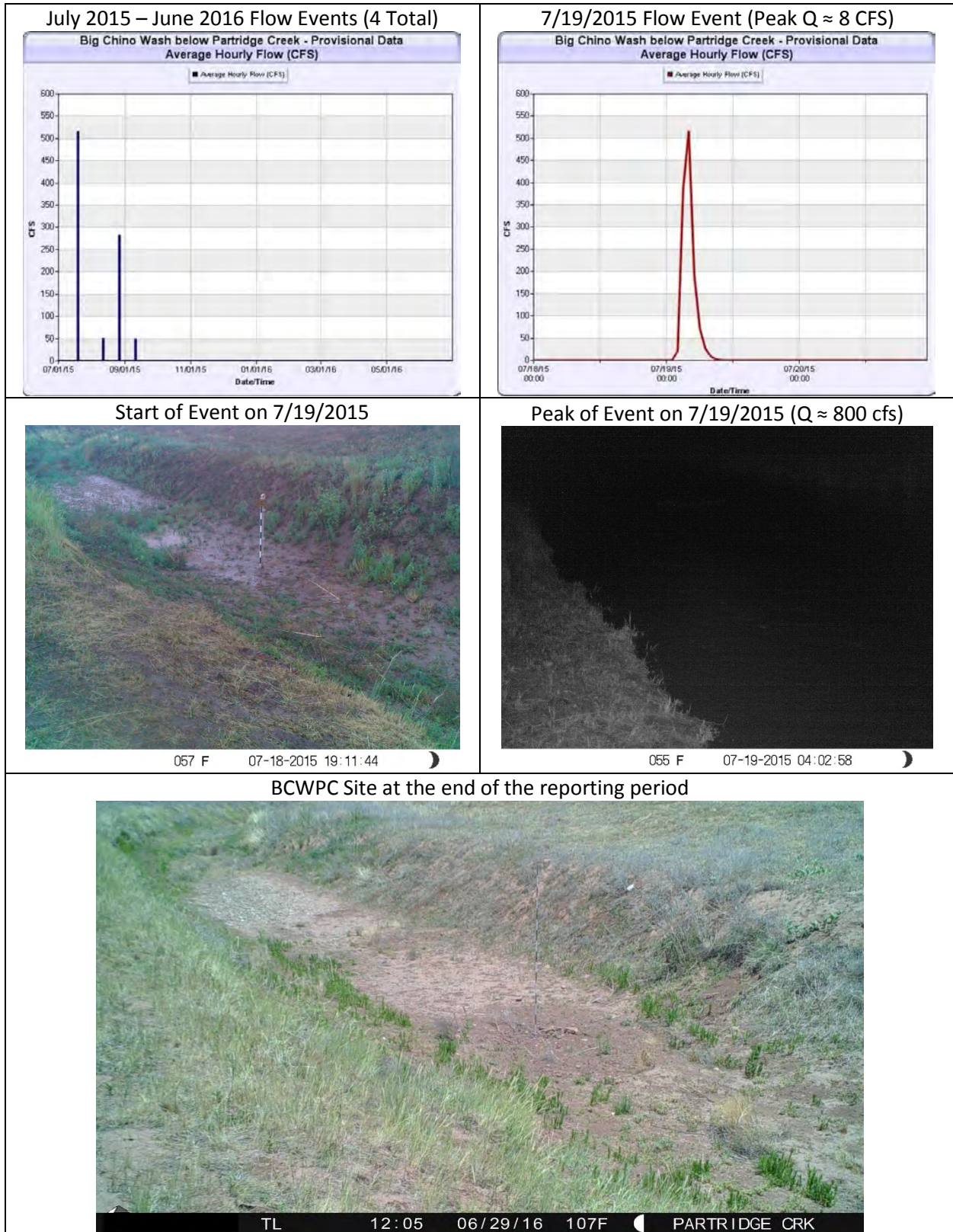
\*\*It is also important to note that the flows observed at BCWPC include the flows observed at UBCW, as UBCW is just upstream of BCWPC.

Note: The previously reported monsoon period (July 2015 – September 2015) is included in this table. No events occurred at the site after the monsoon period.

The BCWPC location was visited a total of nine (9) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Straightened damaged event gages.
- Replaced damaged upstream and downstream event gages.
- Site connectivity repairs.
- Installation of a whip style event gage.
- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of new pressure transducer housings at the upstream and downstream event gages.
- Installation of image loss prevention equipment, lithium batteries, and a secondary camera.

Figure 5: Big Chino Wash below Partridge Creek Hydrographs and SRP Flowtography® Flow Event Images

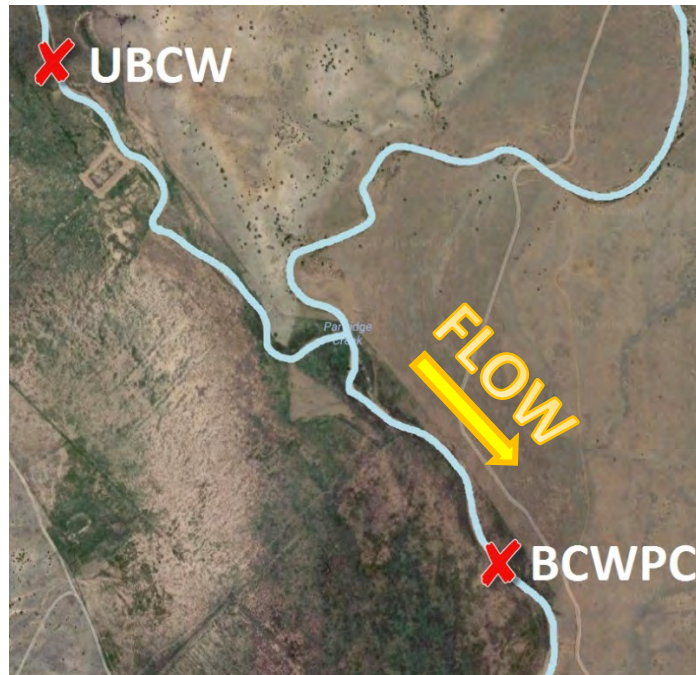




## Partridge Creek

Partridge Creek originates in McIntyre Canyon and joins the Big Chino Wash north of the BCWPC gage, and downstream of the UBCW gage. The flows at BCWPC can therefore be described as a combination of flows from those observed at UBCW, and those from Partridge Creek (not instrumented). See Figure 6 for a map of the streams and existing monitoring locations. The red 'X' marks on the map note existing monitoring locations.

Figure 6: Partridge Creek in relation to UBCW and BCWPC monitoring locations



A portion of the flows observed at BCWPC come from UBCW, while another portion come from Partridge Creek (See Table 5).

Table 5: Partridge Creek - Portion of flows at BCWPC not observed/originating at UBCW

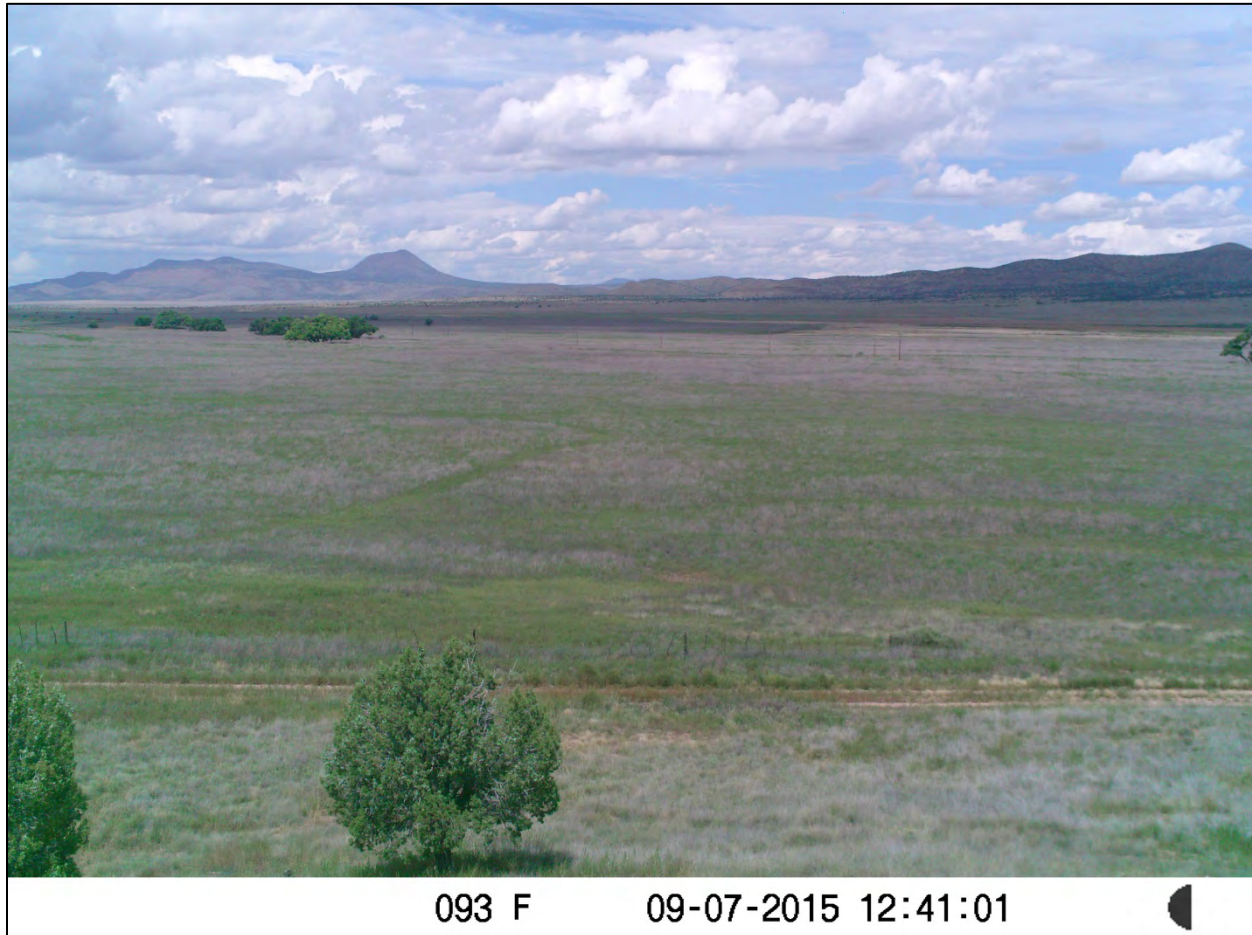
Start Date	UBCW Total Volume (AF)	BCWPC Total Volume (AF)	Partridge Creek Total Volume (AF)*
7/19/2015	0.3	101	100.7
8/11/2015	4	7	3
8/26/2015	6	54	48
9/10/2015	0.8	6	5.2
<b>Totals</b>			<b>156.9</b>

\*Partridge Creek Total Volume derived by subtracting UBCW contribution from BCWPC flow volumes.

## Big Chino Wash at Prescott Ranch (BCWPR)

On August 26, 2015, a camera was installed downstream of the UBCW and BCWPC monitoring sites on the City of Prescott Ranch property. The site is equipped with a camera only, and the goal of the site is to observe if and when large flow events in the basin result in pooled water. See Figure 7 below for an image from the Prescott Ranch SRP Flowtography® Camera. Of all flow events observed upstream of the BCWPR between July 2015 and June 2016, there were no events that caused pooling of water in the larger area captured by the BCWPR SRP Flowtography® camera only assembly.

Figure 7: Big Chino Wash at Prescott Ranch SRP Flowtography® Image



The BCWPR location was visited a total of six (6) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Site connectivity repairs.
- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of image loss prevention equipment, lithium batteries, and secondary camera.

## Pine Creek (PC)

Eight (8) flow events were recorded at Pine Creek (PC) during the period from July 1, 2015 through June 30, 2016. All flow events occurred during the previously reported monsoon period. Peak discharge during the flow events ranged from 2 CFS on August 11, 2015 to 2,350 CFS on September 22, 2015. Total volume of each event ranged from 0.1 AF to 230 AF, with 230 AF occurring on September 22, 2015 (Table 6 and Figure 8). A total volume of 342.3 AF was estimated to flow through the PC location during the 2015-2016 annual reporting period. Individual events ranged in duration from 1 to 15 hours, with a total duration of 53 hours.

Table 6: Pine Creek July 2015 - June 2016 Annual Flow Events

Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/3/2015	18:00	1	0.20	5	0.2
7/6/2015	14:30	14	1.30	95	23
7/18/2015	17:00	4	0.65	25	3
8/11/2015	11:30	1	0.10	2	0.1
8/12/2015	06:30	5	0.75	33	4
9/6/2015	01:30	4	0.80	37	4
9/10/2015	16:00	15	3.15 <sup>a</sup>	725 <sup>a</sup>	78
9/22/2015	16:30	9	5.50 <sup>a</sup>	2,350 <sup>a</sup>	230
<b>Totals</b>		<b>53</b>	<b>5.50<sup>a</sup></b>	<b>2,350<sup>a</sup></b>	<b>342.3</b>

<sup>a</sup> Stage exceeded original survey bank full (stage=2.30').

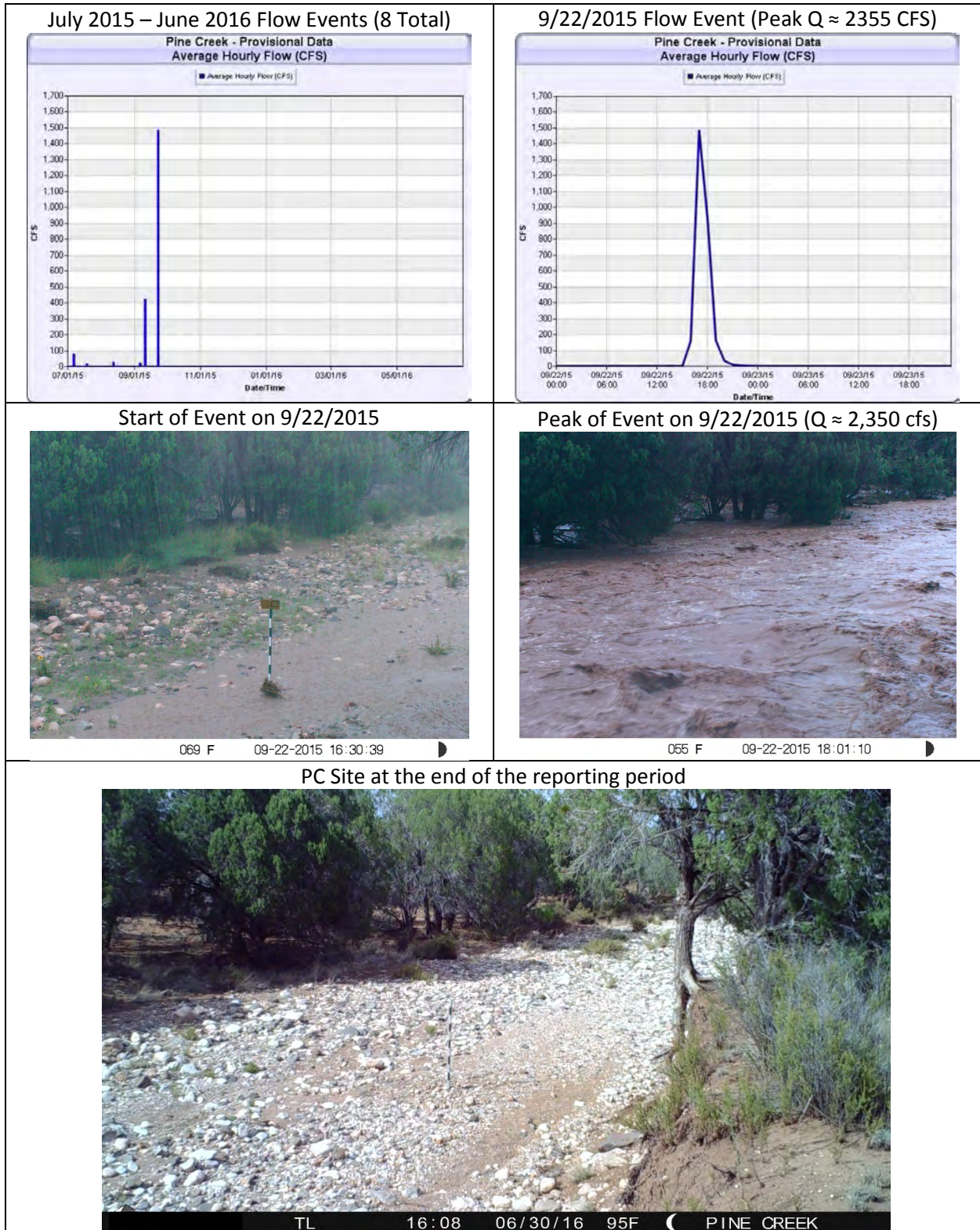
\* Start times are approximate within 15 minutes and events may continue into the following days.

Note: The previously reported monsoon period (July 2015 – September 2015) is included in this table. No events occurred at the site after the monsoon period.

The PC location was visited a total of eight (8) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Site connectivity repairs.
- Replacement of upstream and downstream event gages.
- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of image loss prevention equipment, lithium batteries, and secondary cameras.
- Cleaning out of the pressure transducer housings.
- Resurvey of the stream channel.
- Installation of new pressure transducer housings at the upstream and downstream event gages.

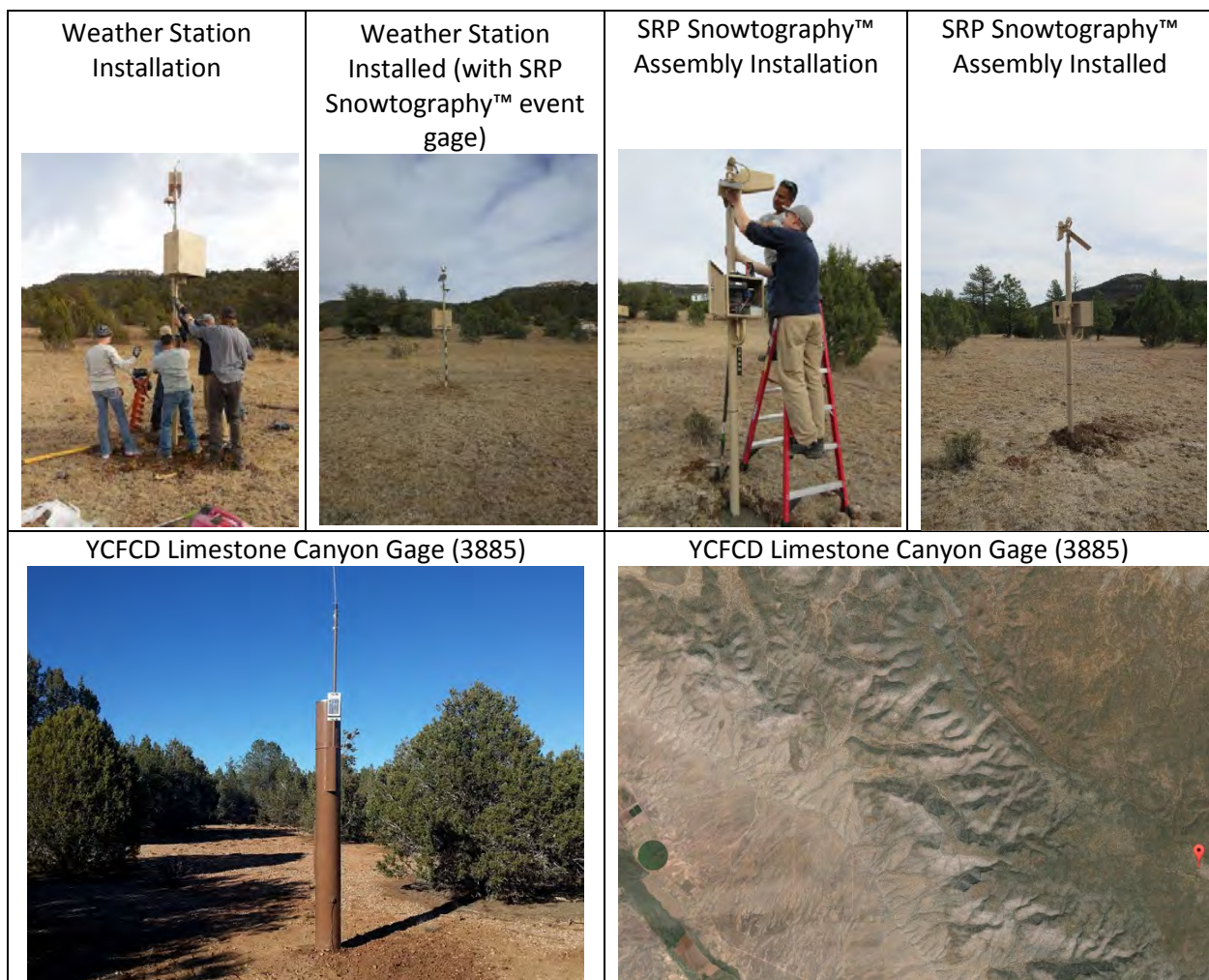
Figure 8: Pine Creek Hydrographs and SRP Flowtopography® Flow Event Images



## George Wood Canyon (GWC)

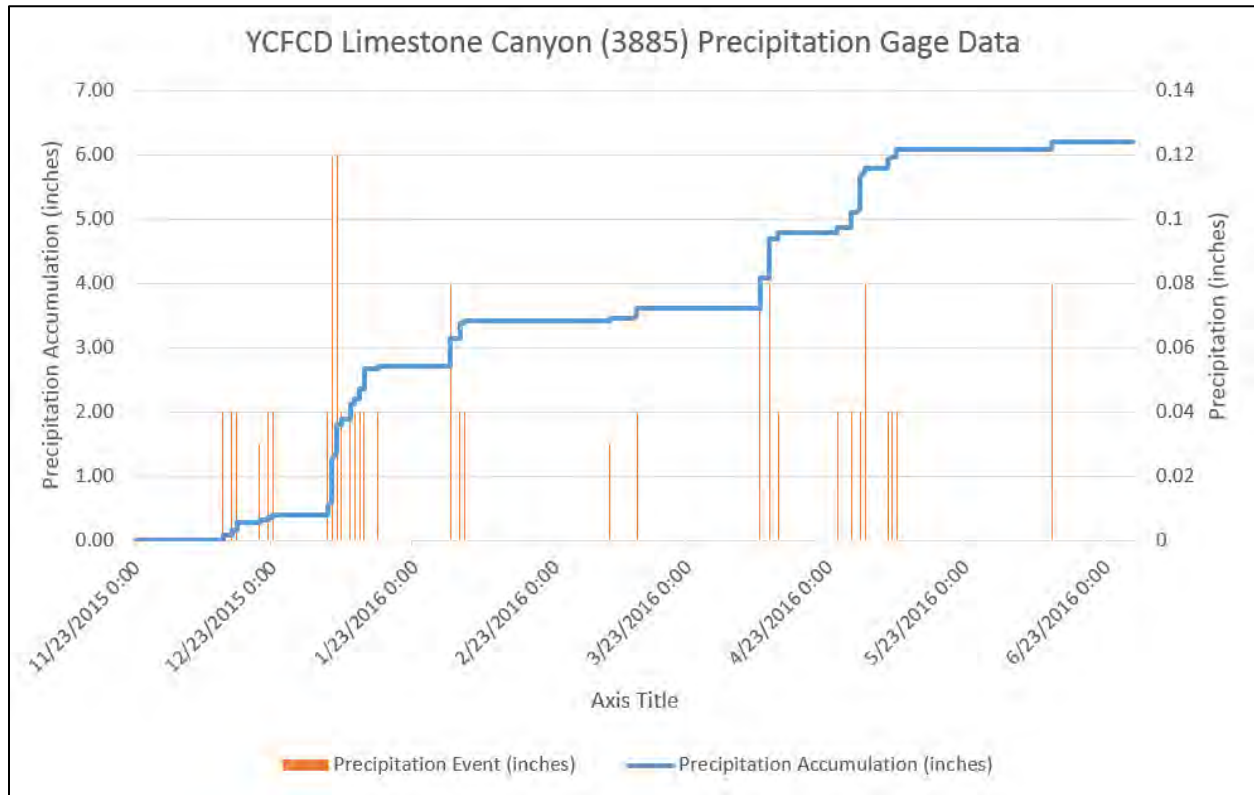
On 12/9/2015, SRP staff installed a weather station (including a WXT520 Vaisala Weather Transmitter), SRP Snowtography™ assembly including a new g26 camera and an event gage at the George Wood Canyon (GWC) location (See Figure 9). The goal of the site is to collect data including: precipitation, barometric pressure, air temperature, wind direction, peak gust, relative humidity, wind speed, and SRP Flowtography® images of snow depth. This weather station is one of two weather stations to be included as part of the CA1 Monitoring Project. The other weather station, at Limestone Canyon, was installed by the Yavapai County Flood Control District (YCFCD) on November 23, 2015 per their website: [weather.ycflood.com:8081/info/3885.html](http://weather.ycflood.com:8081/info/3885.html). The gage is approximately 9.5 miles east of the Prescott Ranch property in Limestone Canyon at 35° 03'15" N and 112° 31' 23" W (See Figure 9 for site image and map and Figure 10 for site data).

Figure 9: George Wood Canyon Weather Station and SRP Snowtography™ Assembly Installation



The YCFCD precipitation gage at Limestone Canyon recorded over six (6) inches of precipitation from the installation date of November 23, 2015 through June 30, 2016 (See Figure 10 for precipitation data).

Figure 10: YCFCD Limestone Canyon – November 2015 through June 2016 Precipitation Data (data from [http://weather.ycflood.com:8081/historicdata/pgi\\_historic\\_report.php](http://weather.ycflood.com:8081/historicdata/pgi_historic_report.php))



At the GWC weather station, five (5) snow accumulation events were recorded during the period from July 1, 2015 through June 30, 2016. Snow depth during the reporting period ranged from 0 ft. to 0.28 ft. (Table 7, Figure 11, and Figure 12). It is important to note that these values do not reflect and calculation for snow water equivalence, and during no event was there visible runoff.

Table 7: George Wood Canyon Snow Accumulation Event Data

Start Date	Start Time*	Snow Measurable at Gage (hrs.)	Peak Snow Depth (ft.)
12/11/2015	20:42	15	0 (dusting only)
12/14/2015	02:06	54	0.19
12/20/2015	05:07	6.5	0.06
1/11/2016	11:23 <sup>a</sup>	50	0.29
1/31/2016	11:41	48	0.20
<b>Totals</b>		<b>173.5</b>	<b>0.29</b>

\*Start times are approximate within 15 minutes and events may continue into the following days.

<sup>a</sup> Due to a camera malfunction on 12/29/2016, the camera was not operational until 1/11/2016. When the camera was fixed, the snow depth recorded started at 0.29 ft. on 1/11/2016 at 11:23am.

Figure 11: George Wood Canyon - December 2015 through June 2016 Precipitation Data

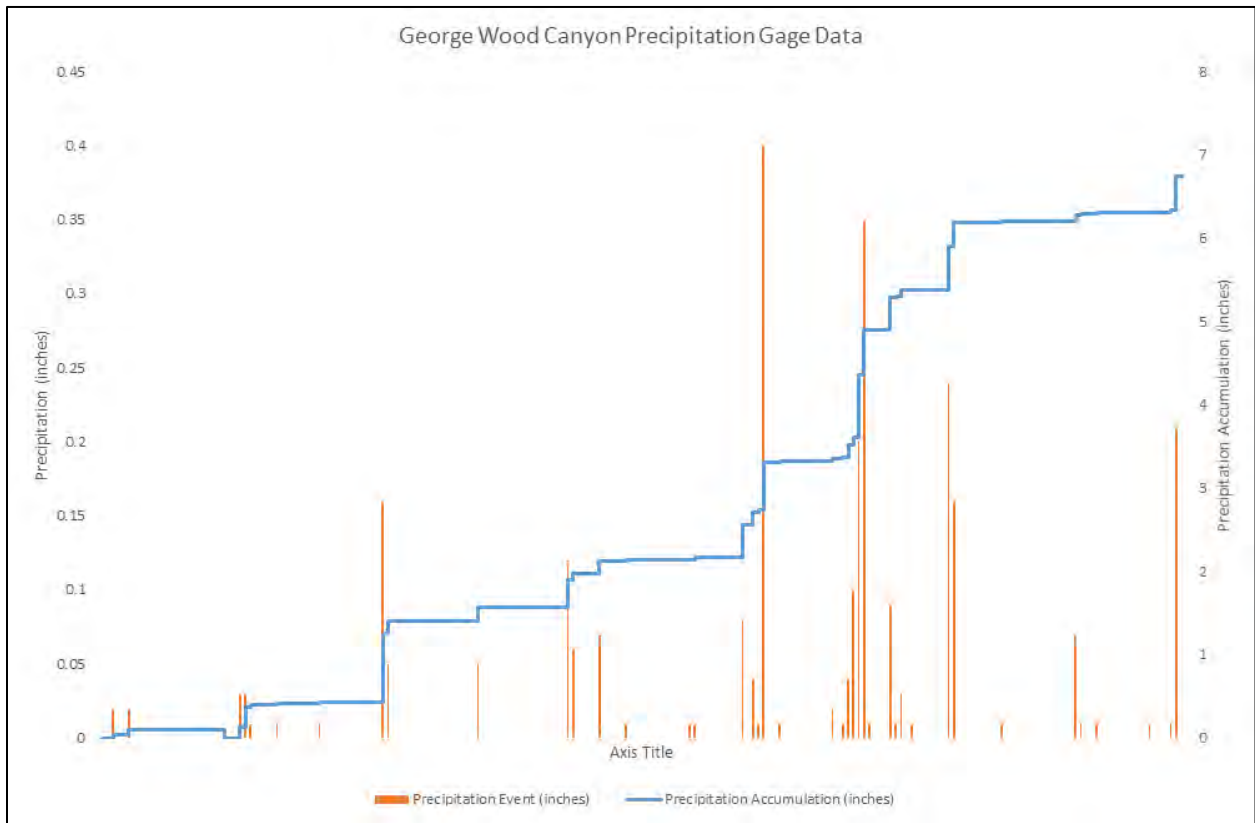
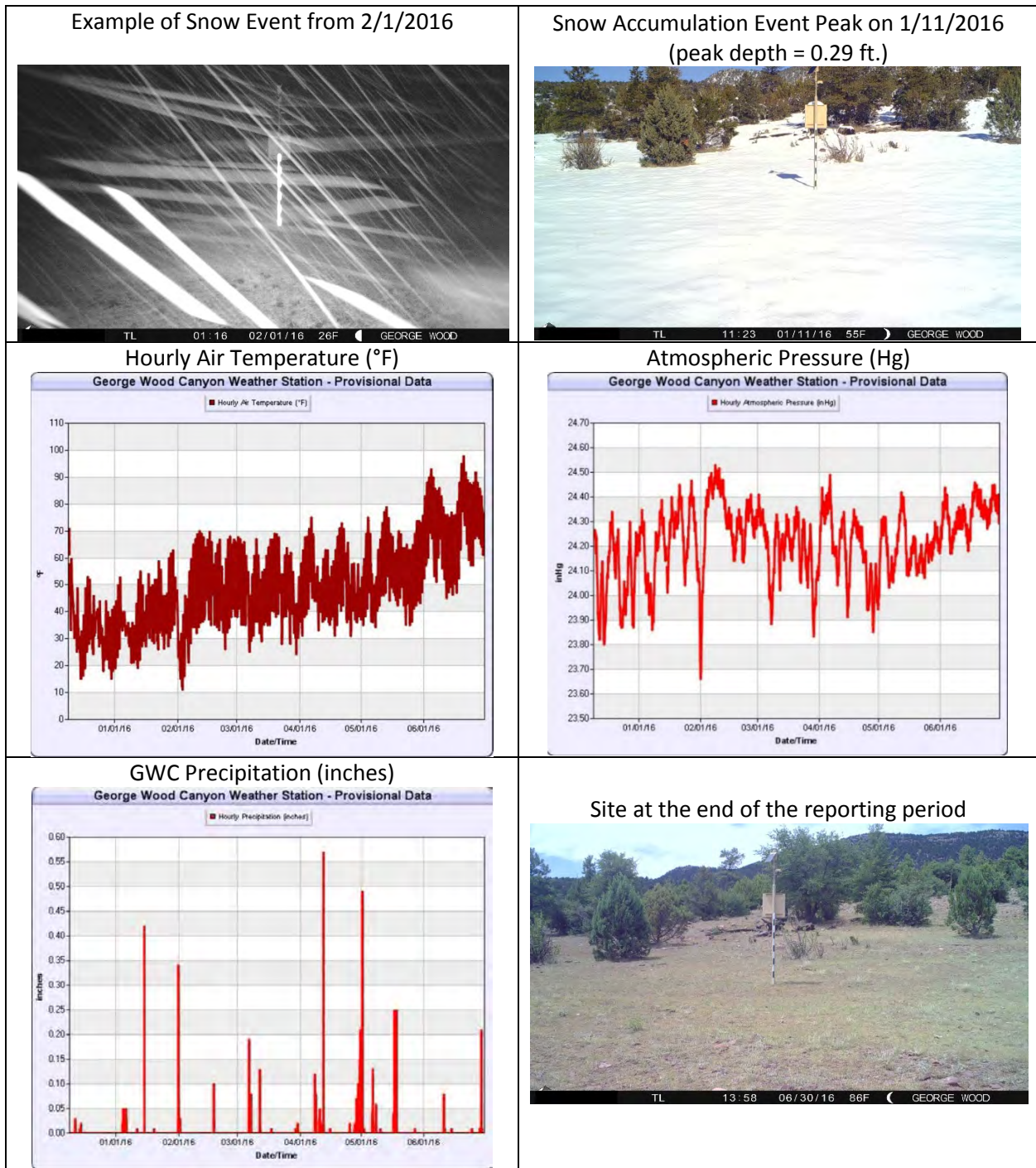


Figure 12: George Wood Canyon Weather Station Data Graphs and SRP Snowtopography™ Site Images

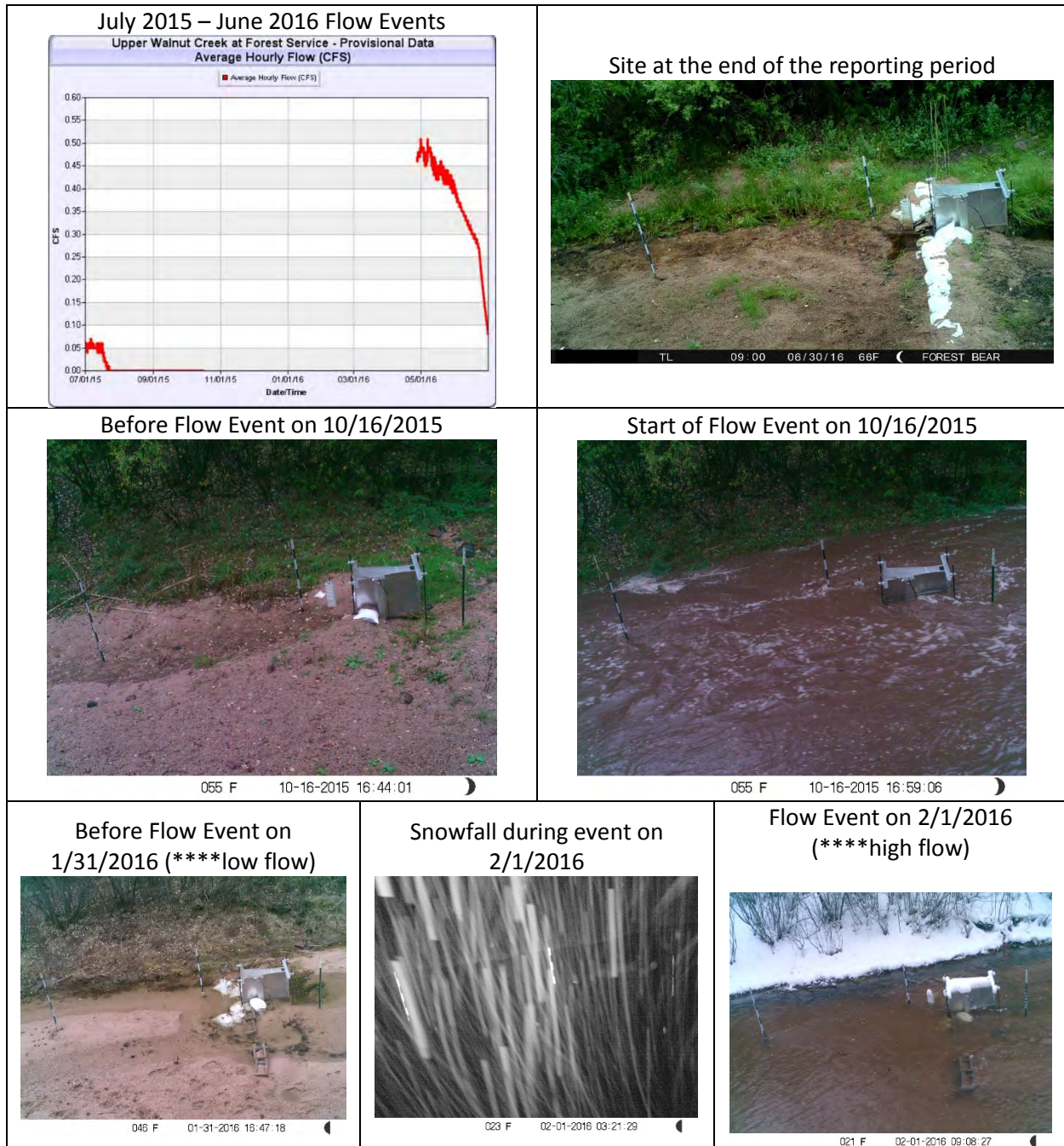




## Upper Walnut Creek at Forest Service (UWCFS)

Five (5) high flow events occurred at the UWCFS location during the period from July 1, 2015 through June 30, 2016 (See Figure 14). The first event occurred on October 16, 2015. This event exceeded the flume capacity, and flowed on both sides of the flume as well as through, also changing the geometry of the flume channel. From this date through April 27, 2016, the flows observed in the channel were both through and outside of the flume. As a result, high and low flow from October 16, 2015 through April 27, 2016 were not measured.

Figure 13: Upper Walnut Creek at Forest Service Hydrographs and SRP Flowtography® Event Images



The UWCFS location was visited a total of six (6) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of image loss prevention equipment, lithium batteries, and secondary camera.
- Redirection of channel flow through the flume, flume channel cleared of debris, and pressure transducer calibrated to flow.

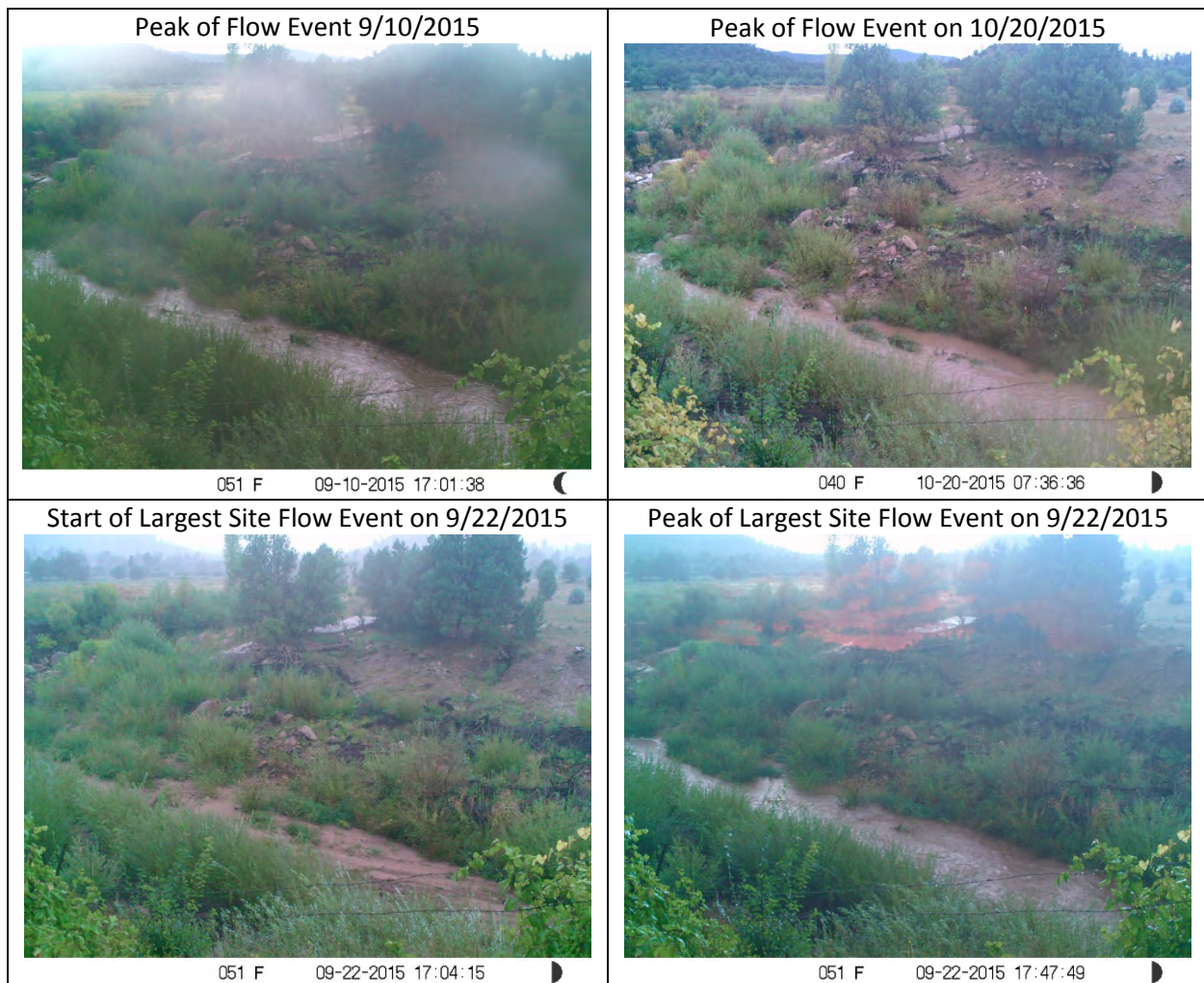
## Upper Walnut Creek at Bridge (UWCB)

The Upper Walnut Creek at the Bridge (UWCB) site experienced four (4) flow events during the period from July 1, 2015 through June 30, 2016 (see Figure 15). This site is equipped with a camera only, which documents flow events downstream of the UWCFs flume during the day only.

The UWCB location was visited a total of six (6) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of image loss prevention equipment, lithium batteries, and secondary camera.

Figure 14: Upper Walnut Creek at Bridge - Flow Event Images



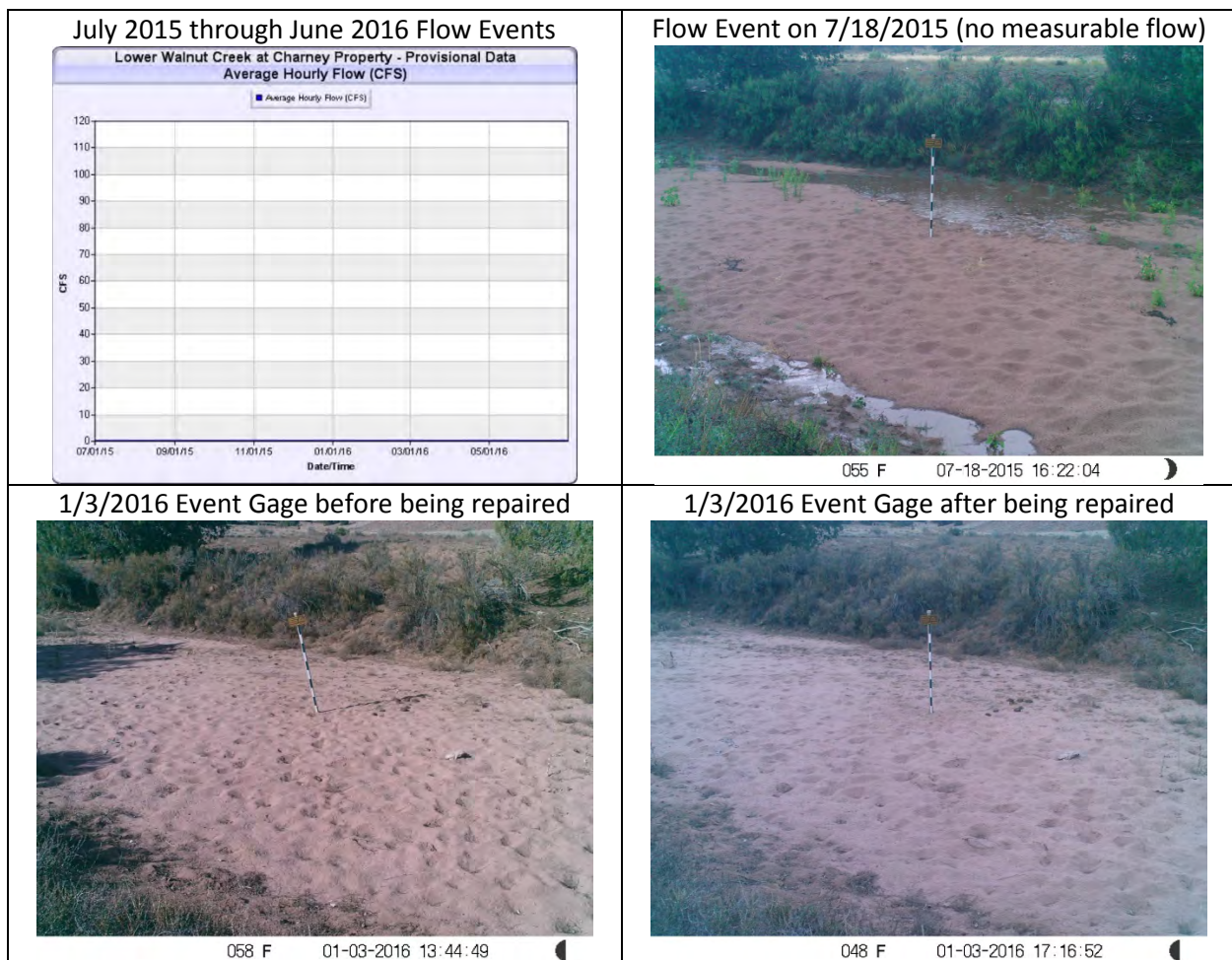
## Lower Walnut Creek at Charney Property (LWCCP)

No measurable flow events were recorded at the Lower Walnut Creek at Charney Property (LWCCP) location during the period from July 1, 2015 through June 30, 2016. An event on 7/18/2015 resulted in a small trace of water pooling on the left bank of the channel, but this water did not reach the event gage nor did the pressure transducer register an increase in stage (See Figure 16). A total volume of 0 AF flowed through the LWCCP location during the 2015-2016 annual reporting period.

The LWCCP location was visited a total of six (6) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Straightening out of the event gage damaged/bent from livestock (see Figure 13).
- Upstream and downstream pressure transducer housings cleaned of debris.
- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of image loss prevention equipment, lithium batteries, and a secondary camera.
- Installation of new pressure transducer housings at the upstream and downstream event gages.
- Resurvey of the stream channel.

Figure 15: Lower Walnut Creek at Charney Property Hydrographs and SRP Flowtography® Images



## Williamson Valley Wash at XU Ranch (WVWXU)

Five (5) flow events were recorded at the Williamson Valley Wash at XU Ranch (WVWXU) site during the period from July 1, 2015 through June 30, 2016. Peak discharge during the flow events ranged from 6 CFS on January 6, 2016 to 140 CFS on October 17, 2015. Total volume of each event ranged from 0.6 AF to 36 AF, with 36 AF occurring on January 31, 2016 (Table 9 and Figure 17). A total volume of 98.6 AF was estimated to flow through the WVWXU location during the 2015-2016 annual reporting period. Individual events ranged in duration from 3 hours to greater than 15 days, with a total duration of 527 hours.

The largest flow event started on January 31, 2016, with a peak stage of 0.63', an estimated peak discharge of 10 CFS, and an estimated total flow of 36 AF. Between July 2015 and June 2016 approximately 98.6 AF were observed at WVWXU.

Table 8: Williamson Valley Wash at XU Ranch July 2015 - June 2016 Annual Flow Events

Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/6/2015	17:30	3	0.25	15	0.6
10/17/2015	16:15	7	0.95	140	22
10/18/2015	05:15	23	0.50	46	28
1/6/2016	22:00	113 (4d17h)	0.52	6	12
1/31/2016	23:15	381 (15d21h)	0.63	10	36
<b>Totals</b>		<b>527</b>	<b>0.95</b>	<b>140</b>	<b>98.6</b>

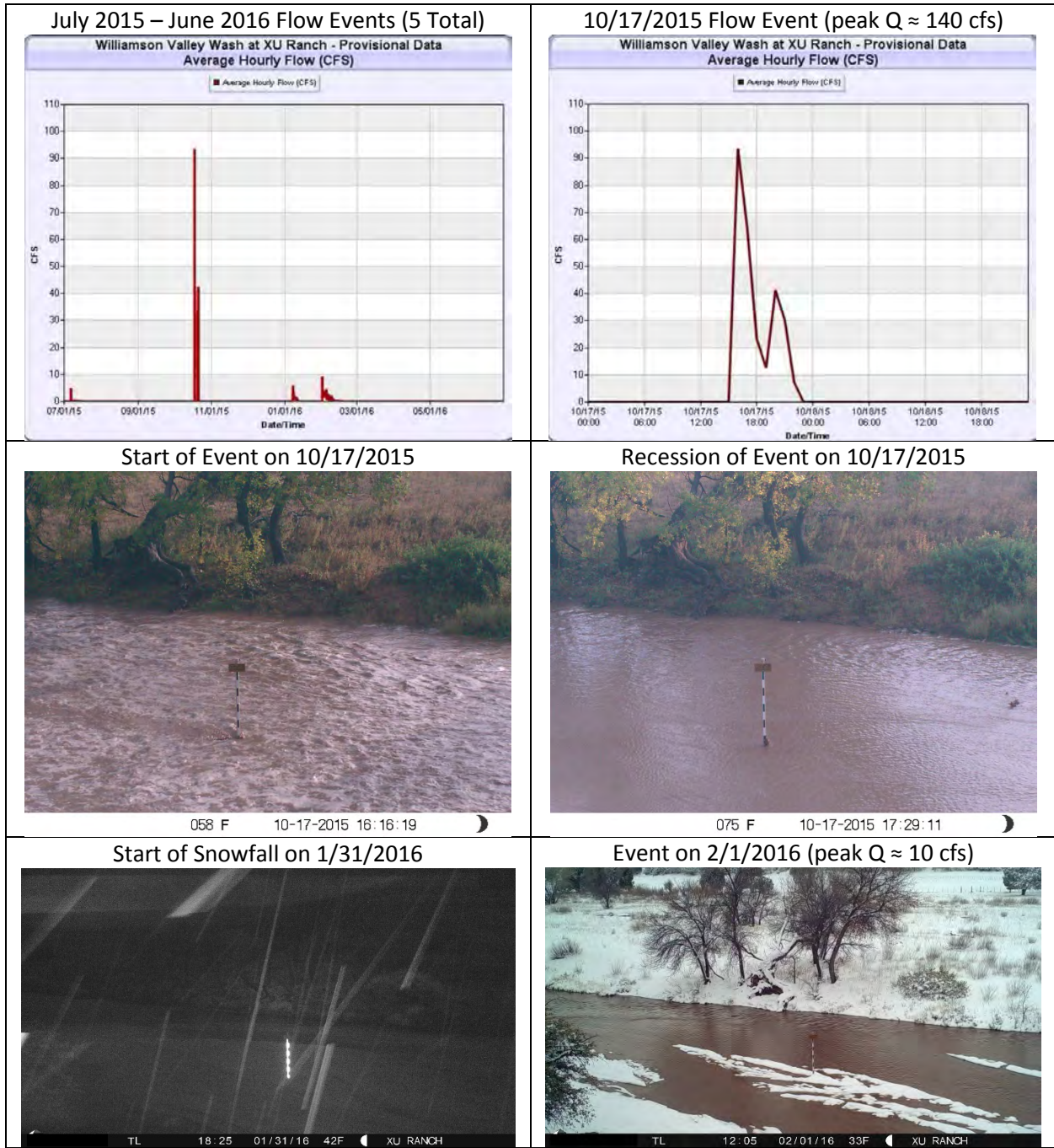
\*Start times are approximate within 15 minutes and events may continue into the following days.

Note: The previously reported monsoon period (July 2015 – September 2015) is included in this table. The most recent unreported period of the winter 2015 - spring 2016 is highlighted **blue**

The WVWXU location was visited a total of seven (7) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Site connectivity repairs.
- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of image loss prevention equipment, lithium batteries, and secondary camera.
- Installation of new pressure transducer housings at the upstream and downstream event gages.
- Resurvey of the stream channel.

Figure 16: Williamson Valley Wash at XU Ranch Hydrographs and SRP Flowtography® Flow Event Images



## Lower Williamson Valley Wash (LWVW)

Two (2) flow events were recorded at the Lower Williamson Valley Wash (LWVW) site during the period from July 1, 2015 through June 30, 2016. All flow events occurred during the previously reported monsoon period. Peak discharge during the flow events ranged from 190 CFS on July 8, 2015 to 300 CFS on August 5, 2015. Total volume of each event ranged from 25 AF to 79 AF, with 79 AF occurring on July 18, 2015 (Table 9 and Figure 17). A total volume of 104 AF was estimated to flow through the LWVW location during the 2015-2016 annual reporting period. Individual events ranged in duration from 9 hours to 11 hours, with a total duration of 20 hours.

Table 9: Lower Williamson Valley Wash July 2015 through June 2016 Annual Flow Events

Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/18/2015	19:00	9	0.90	300	79
8/5/2015	17:30	11	0.70	190	25
<b>Total</b>		20	0.90	300	104

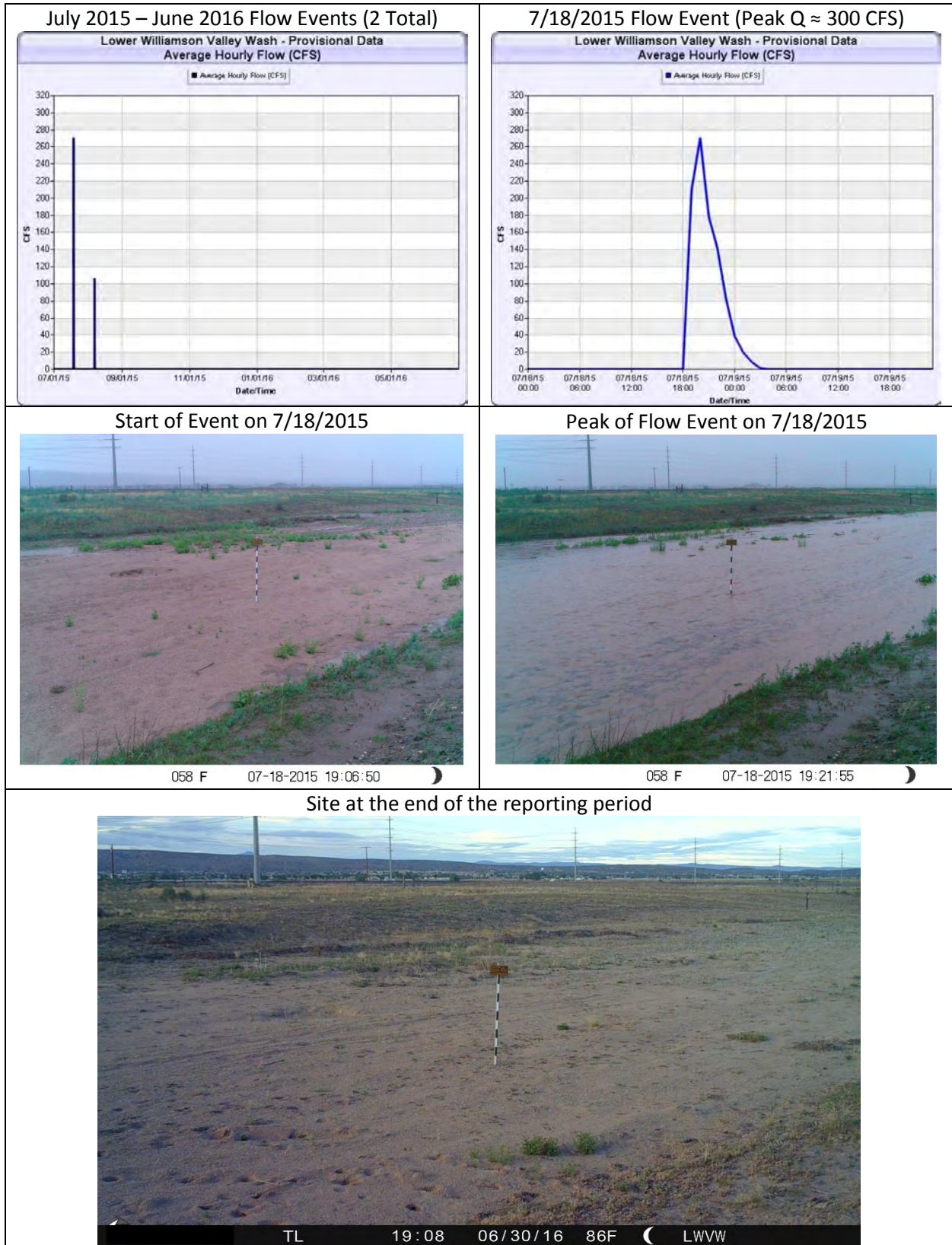
\*Start Times are approximate within 15 minutes and events may continue into the next day.

Note: The previously reported monsoon period (July 2015 – September 2015) is included in this table. No events occurred at the site after the monsoon period.

The LWVW location was visited a total of nine (9) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Site connectivity repairs.
- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of image loss prevention equipment, lithium batteries, and a secondary camera.
- Installation of new pressure transducer housings at the upstream and downstream event gages.

Figure 17: Lower Williamson Valley Wash Hydrographs and SRP Flowtography® Flow Event Images





## Lower Big Chino Wash (LBCW)

One (1) flow event was recorded at the Lower Big Chino Wash (LBCW) site during the period from July 1, 2015 through June 30, 2016. The flow event occurred during the previously reported monsoon period. The one flow event started on 7/19/2015, with an estimated peak stage of 1.4', an approximate peak discharge of 15 CFS, and an approximate total flow of 9 AF. Between July 2015 and June 2016 approximately 9 AF were observed at LBCW (See Table 11 and Figure 19).

Table 10: Lower Big Chino Wash July 2015 through June 2016 Annual Flow Events

Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/19/2015	03:00	11	1.40	15	9
<b>Total</b>		11	1.40	15	9

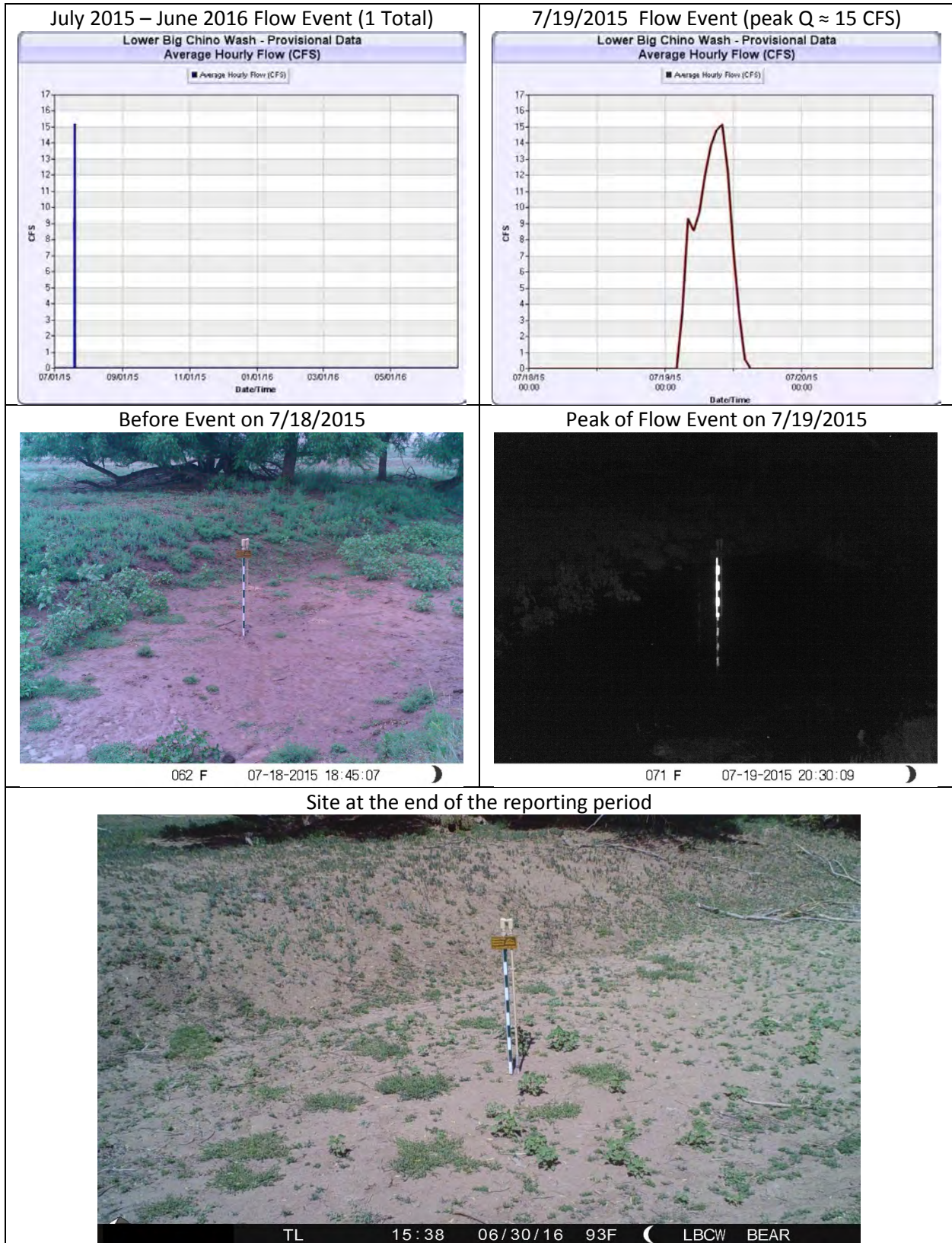
\*Start Times are approximate within 15 minutes and events may continue into the next day.

Note: The previously reported monsoon period (July 2015 – September 2015) is included in this table. No events occurred at the site after the monsoon period.

The LBCW location was visited a total of ten (10) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Site connectivity repairs.
- Primary camera replaced with a new g26 time-lapse and PIR mode camera.
- Installation of image loss prevention equipment, lithium batteries, and a secondary camera.
- Installation of new pressure transducer housings at the upstream and downstream event gages.

Figure 18: Lower Big Chino Wash Hydrographs and SRP Flowtography® Flow Event Images



## Sullivan Dam (SD)

On May 25, 2016, a SRP Flowtography® camera only assembly was installed in the right-of-way on Old Highway 89 facing Sullivan Lake Dam (see Figure 20). Three cameras were installed to collect 15 minute images of the dam. The purpose of the site is to record any periods of flows from Lower Big Chino spilling over the dam, and potentially contributing to the Verde Headwaters at Campbell Ranch (VHCR) gage. No flow events were capture after the installation date during the July 2015 through June 2016 reporting period

Figure 19: Sullivan Lake Dam SRP Flowtography® Camera Only Assembly Installation and Site Images



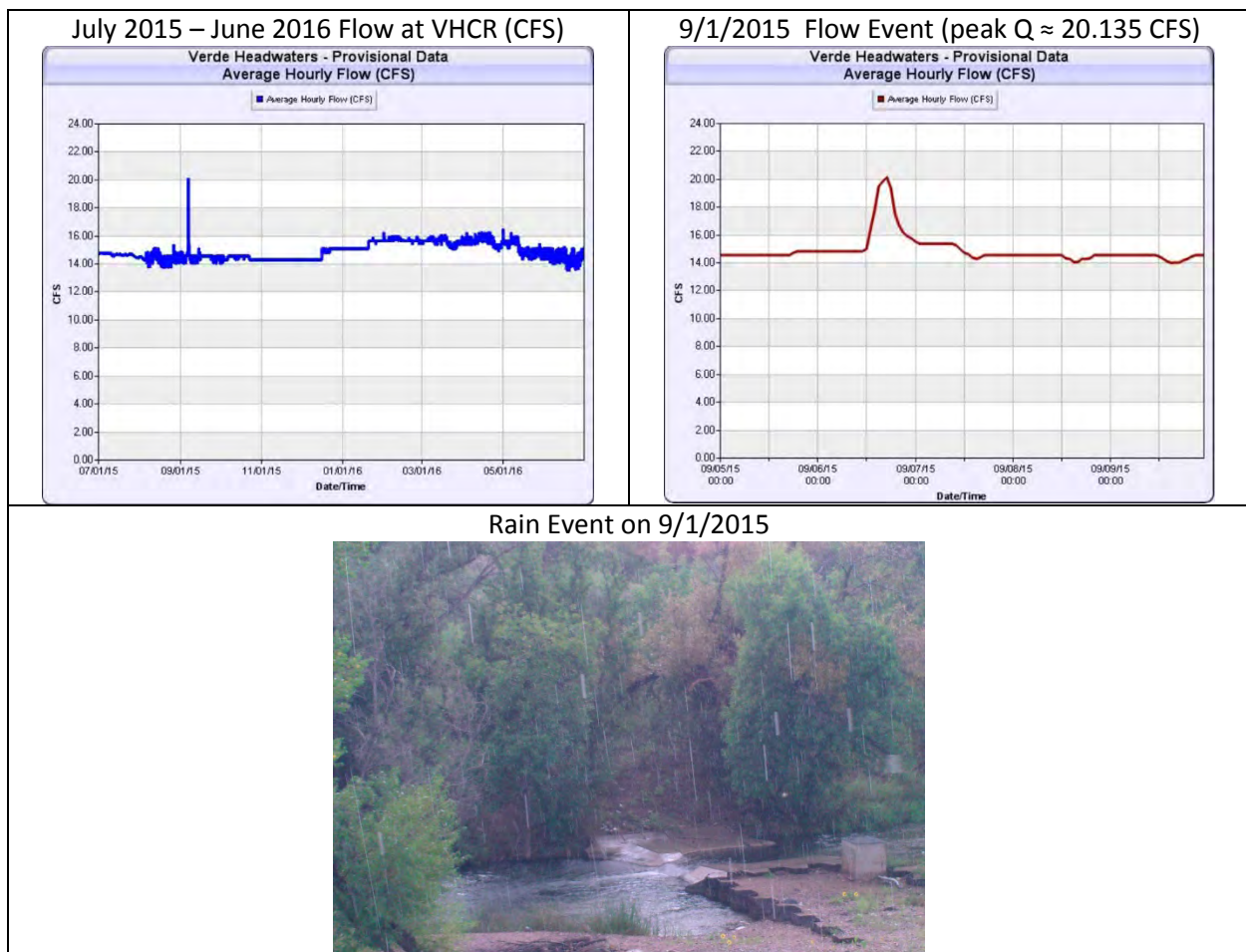
## Verde Headwaters at Campbell Ranch (VHCR)

The Verde Headwaters at Campbell Ranch (VHCR) site experienced one flow event during the period from July 1, 2015 through June 30, 2016 (See Figure 21). The typical daily flow was between approximately 14 and 16 CFS, with a peak flow 20.1 CFS observed on September 6, 2015. The Lower Big Chino Wash did not record a flow that day, so the water most likely originated downstream of Sullivan Dam and the Big Chino Basin. The additional flow that day added approximately 3.5 AF to the total discharge. The total discharge for the site for July 1, 2015 through June 30, 2016 was approximately 10,836 AF.

The VHCR location was visited a total of eight (8) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Troubleshoot tape gage issue. The tape gage was reading same value, and not changing. Discovered that the encoder needed to be replaced to fix this issue.
- Replacement of the encoder.
- Replacement of the data logger due to inaccurate recordings of transducer values.

Figure 20: Verde Headwaters near Campbell Ranch Hydrographs and Site Images



## Gipe Well (GW)

The Gipe Well (GW) location records the depth to water (stage in feet below land surface) and is located in the southeastern portion of the sub-basin approximately 7 miles northeast of Sullivan Sam.

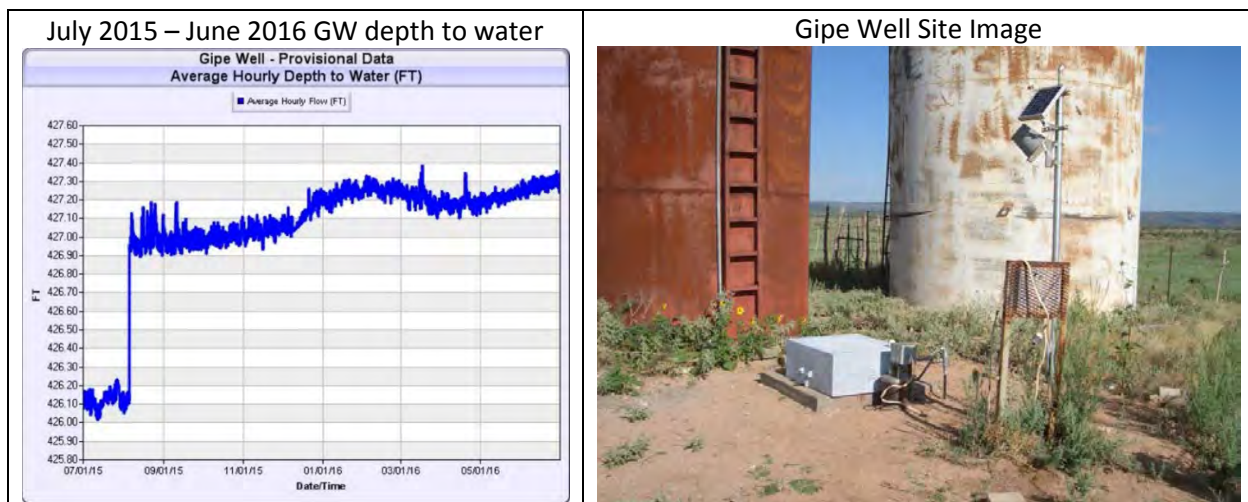
Groundwater levels remain relatively stable at approximately 427 feet (see Figure 22).

During May 2015 the pressure transducer started exhibiting scaling issues. On August 5, 2015 the pressure transducer was replaced with a new one resulting in an adjustment going forward. On August 14, 2015 another well sounding was completed to verify that the adjustment was correct.

The GW location was visited a total of six (6) times during the July 2015 through June 2016 annual reporting period, with an additional visit on July 6, 2016 to collect data and prepare the location for monsoon season. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced the pressure transducer with a new one.
- Conducted a well sounding to verify the pressure transducer readings.
- Replacement of the battery at the site.

Figure 21: Gipe Well Hydrograph (depth to water in feet) and Site Images



## Additional Activities and Observations

In addition to routine maintenance and data collection and processing for each location, the following activities and observations were completed during the July 2015 through June 2016 annual reporting period:

- The primary camera was upgraded to the newest model g26 style at each location, with the addition of a lithium battery.
- Image loss prevention equipment with secondary cameras and secondary lithium batteries added to each location.

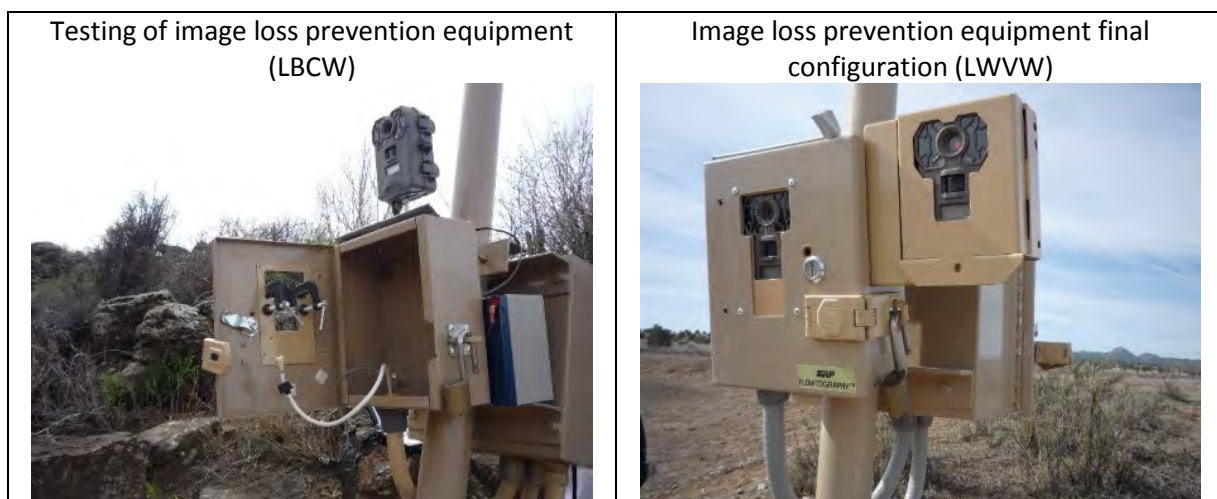
- Equipment modifications were completed to all upstream and downstream event gages. Each pressure transducer housing was replaced with an upgraded model, which will enhance the response of the pressure transducer readings.
- Captured snow accumulation and runoff in SRP Flowtography® images at multiple locations.
- Installed a SRP Flowtography® camera only assembly at Big Chino Wash at Prescott Ranch and Sullivan Dam.
- Installed a weather station and SRP Snowtography™ assembly at the George Wood Canyon location.

### Maintenance and Equipment Modifications

Equipment modifications were facilitated at all SRP Flowtography® stations during the July 2015 through June 2016 annual reporting period. Pressure transducer housings were removed and replaced with a more efficient and enhanced design. The new design will allow for water to flow more freely within the pressure transducer housings for more responsive pressure sensor data.

Primary cameras were replaced with the newest model g26 style camera, and image loss prevention equipment with secondary cameras and lithium batteries were installed (See Figure 23). Primary camera settings were changed to take images every hour. Due to the cellular connection in the area, the cameras often got tied up transmitting the 15 minute images. This hourly setting was to reduce the amount of camera errors, and thus reduce the amount of service trips needed to repair the cameras. The secondary camera was set to take the 15 minute images, as well as PIR images of flow. The g26 model was chosen for its simultaneous time-lapse and PIR (Passive Infrared) capabilities. The PIR setting allows for images to be taken when the infrared sensor detects motion. After the cameras were upgraded, settings set to take images every one hour, and secondary cameras installed, there have been no service trips to diagnose and repair camera transmission issues.

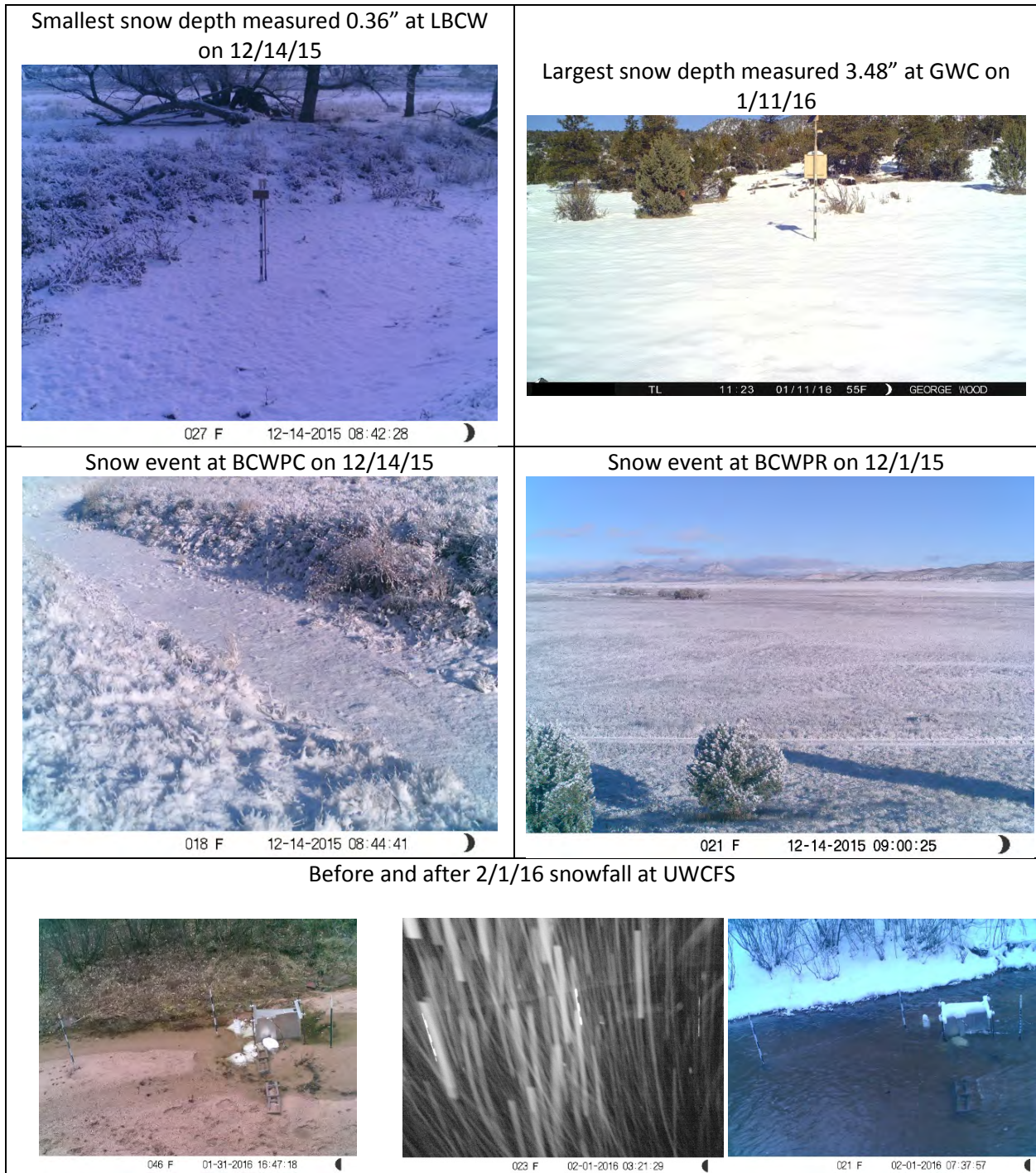
Figure 22: Equipment modifications at Big Chino SRP Flowtography® locations.

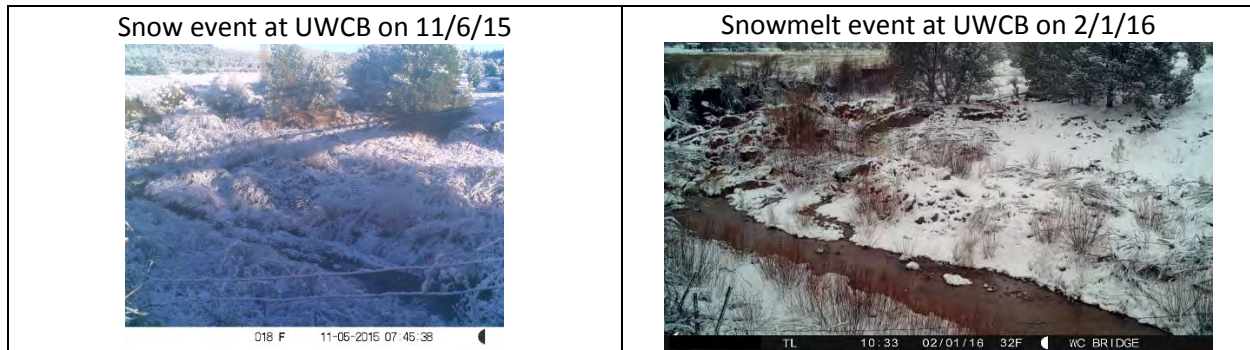


## Snow Accumulation Observations

Snow accumulation was observed at multiple locations in the sub-basin during the period from July 1, 2015 through June 30, 2016. Maximum snow depths measured at the event gages ranged from 0.36" at LBCW on December 14, 2015 to 3.48" at GWC on January 11, 2016. See Figure 24 for snow accumulation event images from the annual reporting period.

Figure 23: Snow Accumulation Events at Big Chino Sub-basin Sites





## Things to Come

Currently there is no event gage at the Sullivan Dam site. The gage has been approved and the appropriate permits acquired. Engineering for the event gage is underway, and the installation is expected to occur in late August or early September of 2016.

The SD site was visited once on July 6, 2016 to collect data for the annual report and prepare the location for monsoon season.

## Conclusions

Flow events during the July 2015 – June 2016 reporting period ranged from a few larger storm events spanning several sites, to many isolated storm events of short duration and resulting in minimal flows. Peak discharge was as high as 2,350 CFS at PC. The majority of flow events occurred at the western sites within the sub-basin. A few regional storm events resulted in flows at SRP Flowtography® locations in the southern and eastern portions of the basin.

A total of 908 AF were recorded to flow at the seven SRP Flowtography® equipped stream flow monitoring locations recording stage level within the Big Chino Sub-basin (excluding BCWPR, GWC, UWCFS, UWCB, and SD).

The July 2015 through June 2016 season was characterized by isolated storm and flow events. The largest event occurred early in the season at PC, accounting for 25% of the total volume of water measured in the basin. Only 9 AF were observed to flow through the LBCW site. Because the SD site was not installed with a gage, it is unknown whether those flows reached SD and/or flowed over the dam, possibly contributing to the flow at VHCR site. This data suggests that most, if not all, of the precipitation during the July 2015 through June 2016 period was contained within the Big Chino Sub-basin.

SRP WM continues to maintain the sites and process pressure transducer data and SRP Flowtography® images collected at the monitoring locations. Additional activities will be detailed in future reports. While stage values are typically more accurate during flow events, discharge values are based on estimated ratings and impacted by changes in the channel cross sections. No invasive stream flow measurements were collected this reporting period. Additional direct current meter measurements would be needed to improve estimates of discharge values in the future. The data presented within this report is 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 Established Under CA#1**

<b>Name</b>	<b>Cadastral Location</b>	<b>Completion Date</b>	<b>Comments</b>
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**

<b>Name</b>	<b>Completion Date</b>	<b>Comments</b>
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	6/10/2014	

Charney Property		
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 reinstalled
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	Camera only, installation of stage gage/transducers pending

### Climate Monitoring

#### **Publicly Accessible Repositories for Climate Data**

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

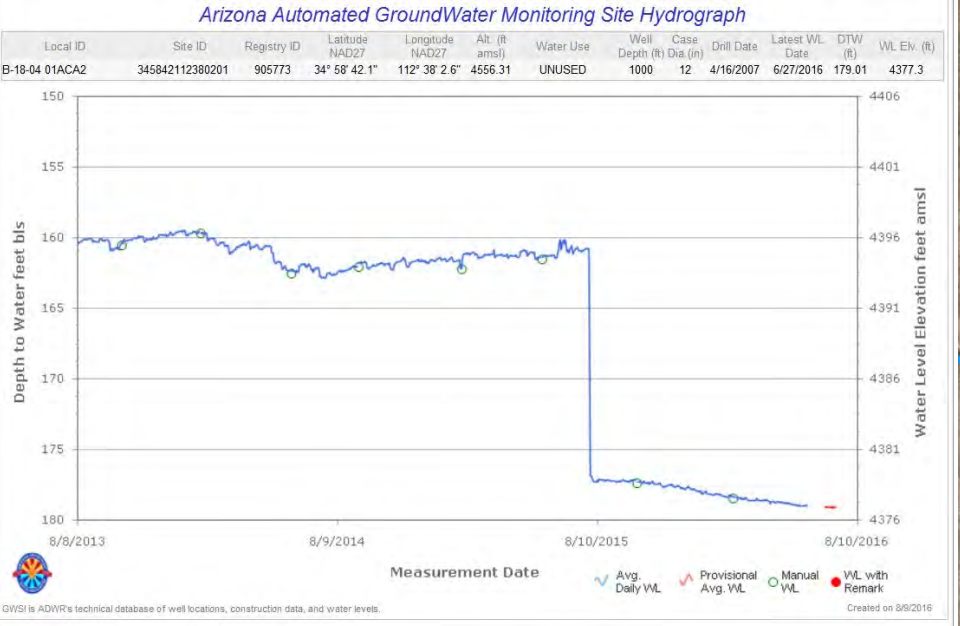
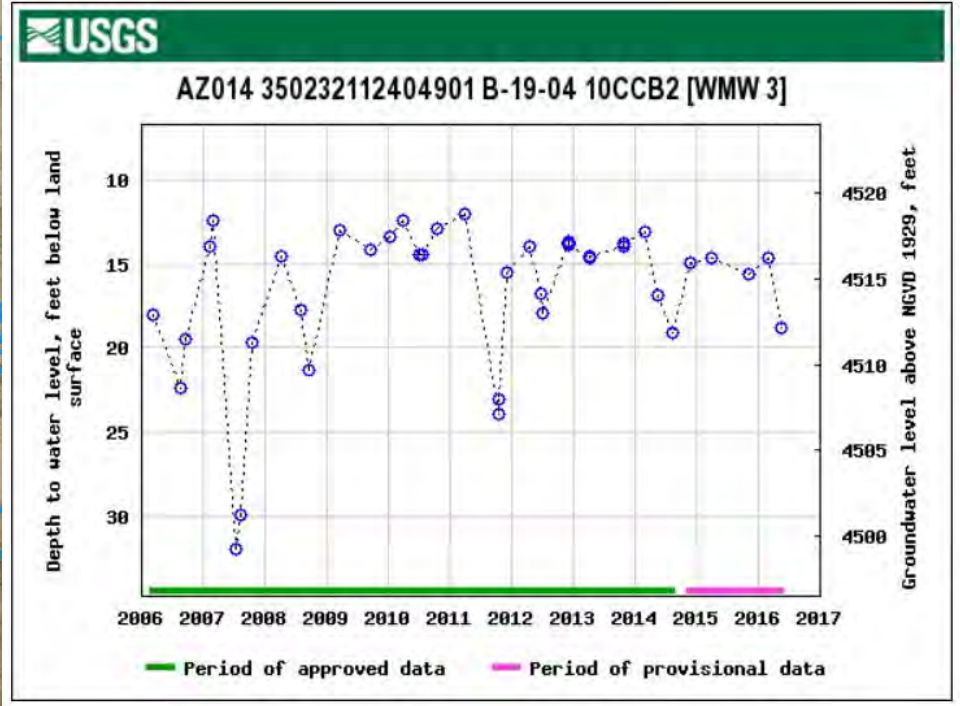
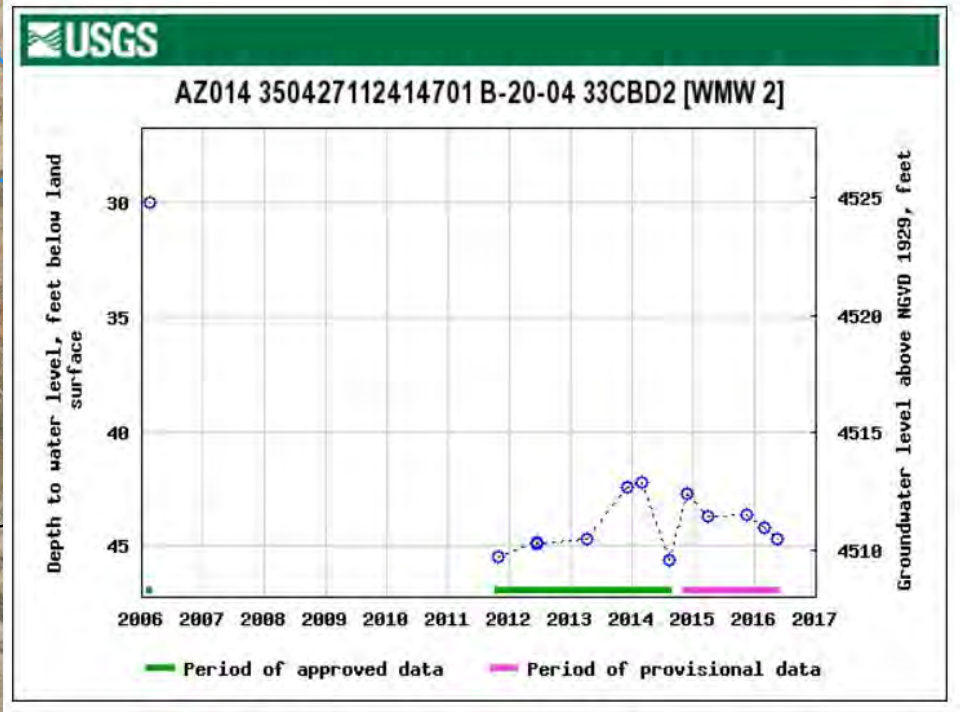
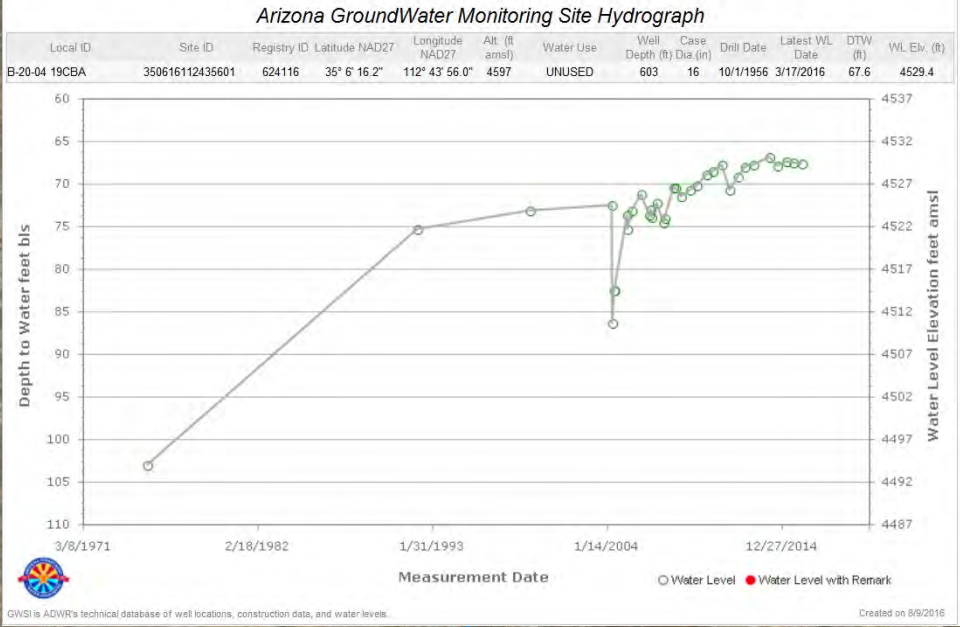
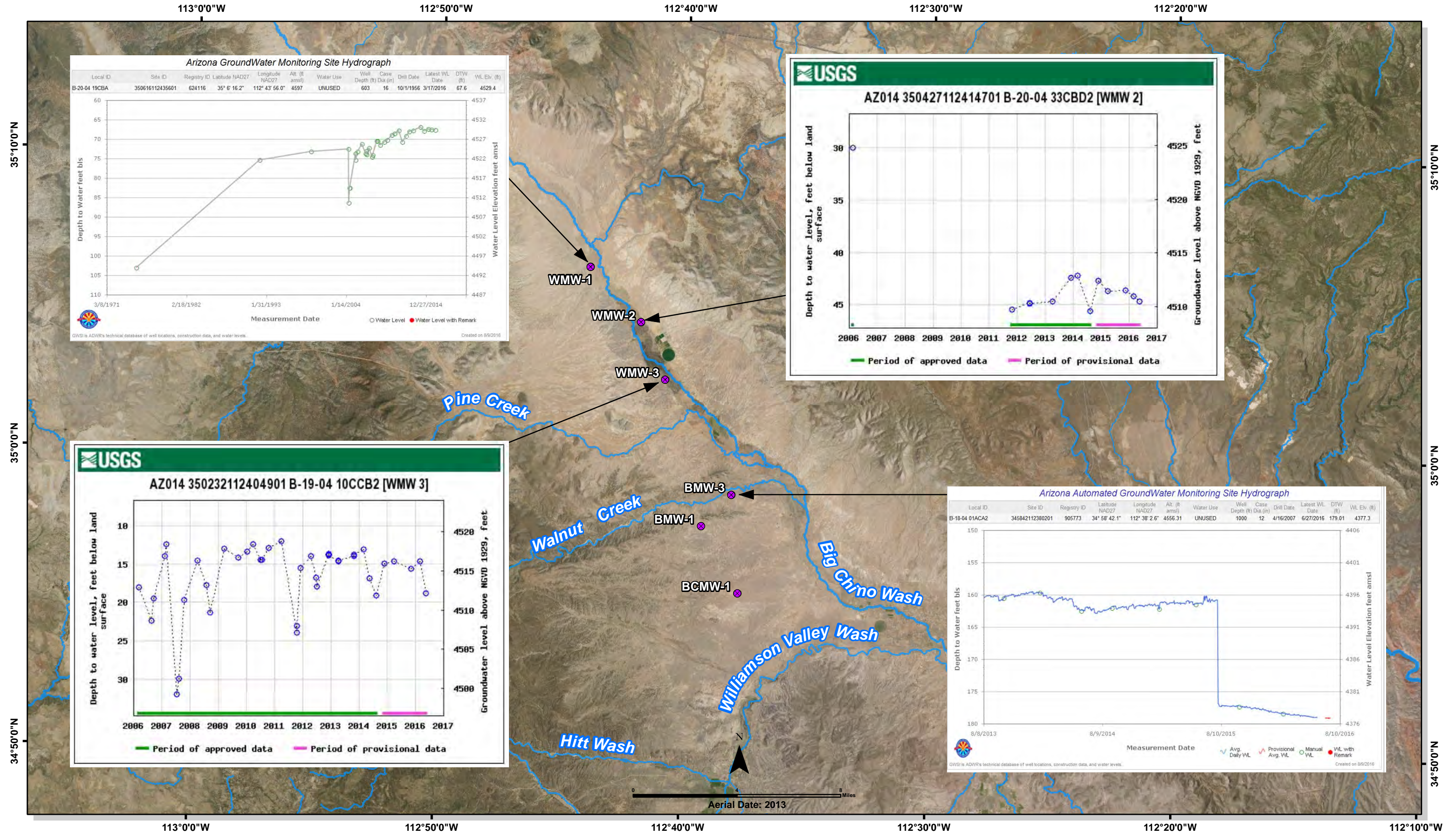
#### **Existing Weather Stations in the Big Chino Sub-basin**

<b>Station Name</b>	<b>Responsible Agency</b>	<b>Data Collected</b>
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 <sup>1</sup>	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

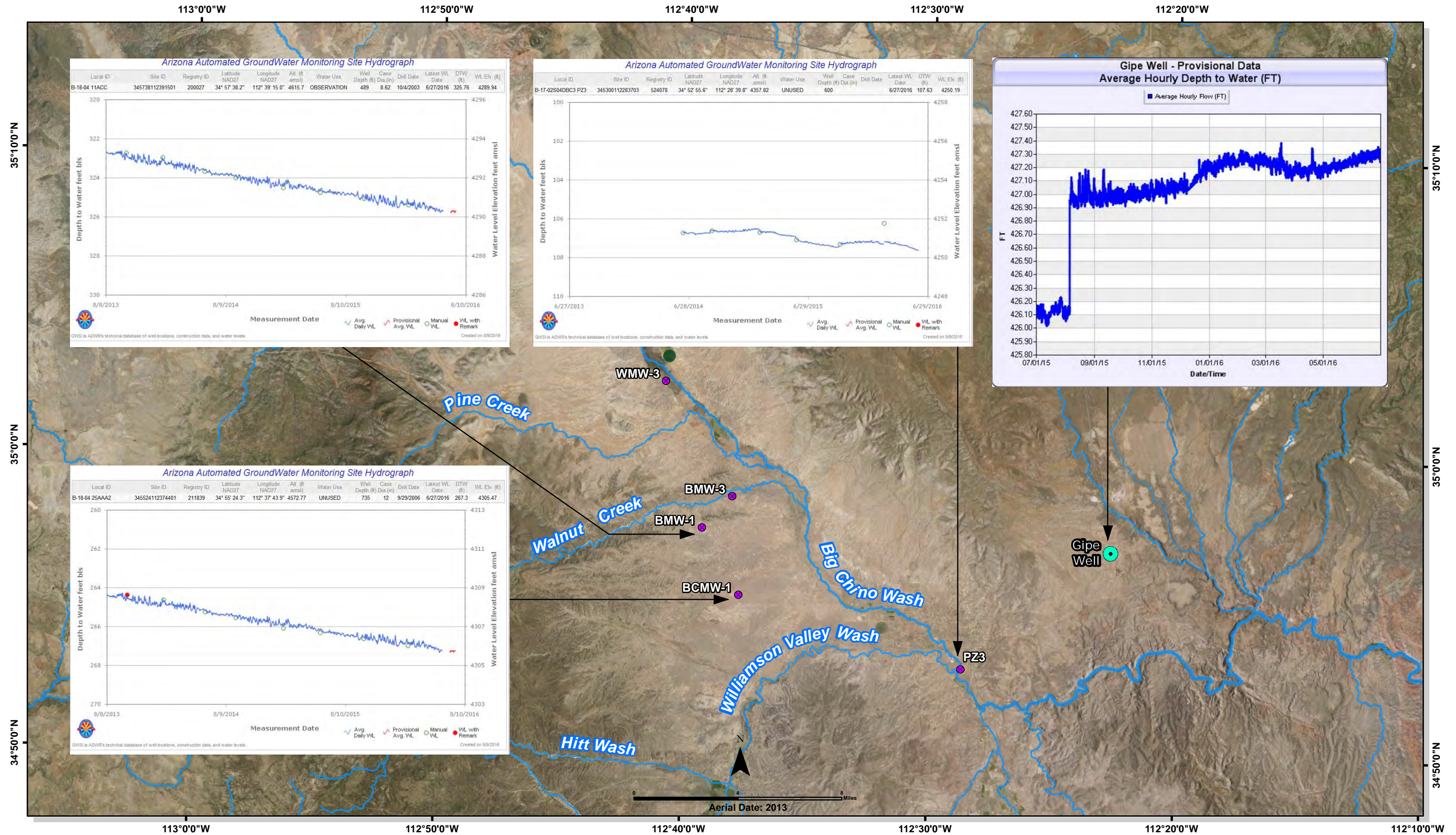
# *APPENDIX III*

## *Maps*



- Existing Monitor Well
- Gipe Well

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



- Existing Monitor Well
- Gipe Well

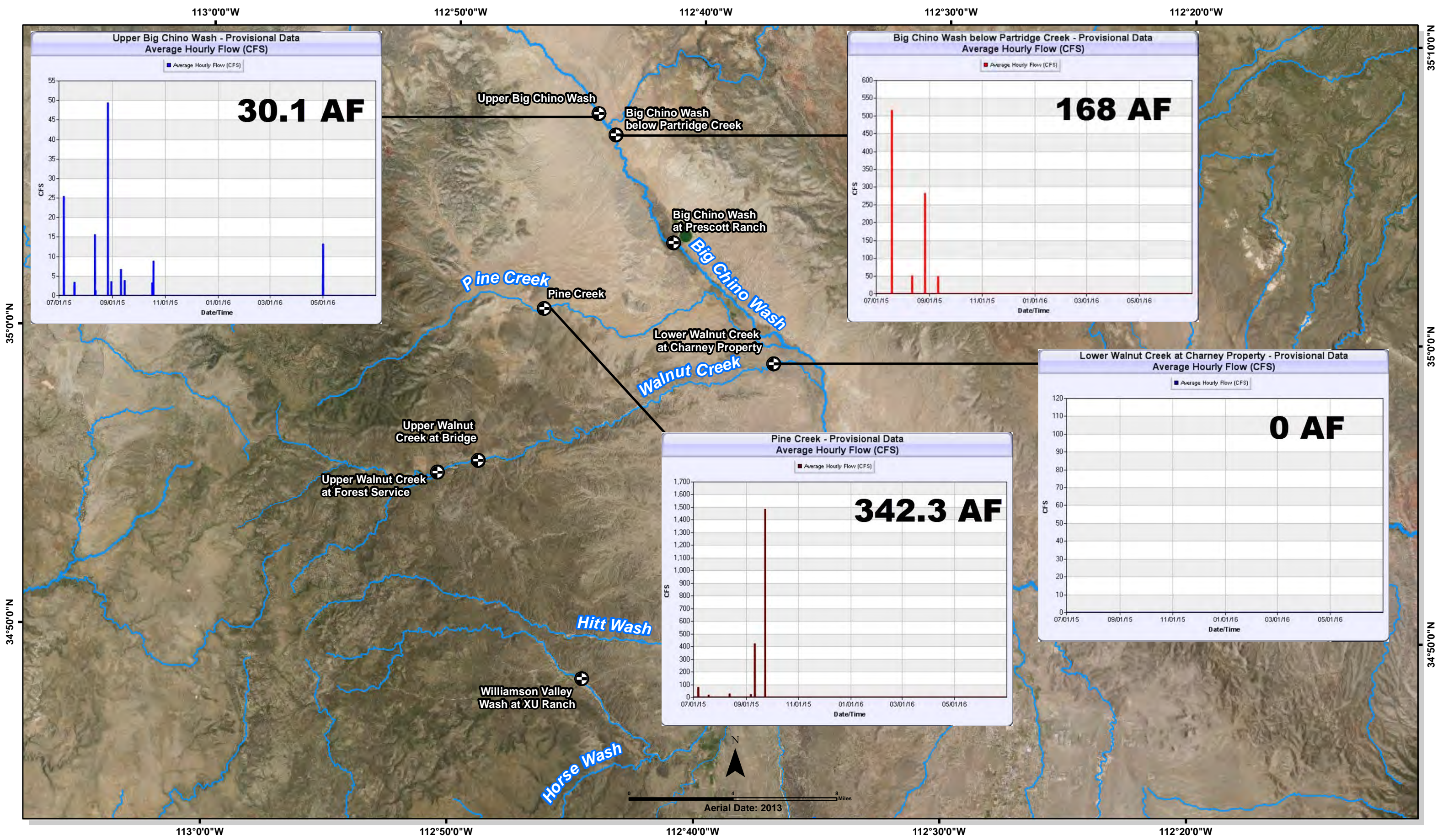
**Map 2**  
**Big Chino Water Ranch/Gipe Well**  
**Southern Existing Monitor Wells**



-  Surface Monitoring Location
-  USGS Gauge
-  Verde Headwaters
-  Creeks & Washes

**Map 3**  
**Big Chino Sub-basin - Surface Water Monitoring**  
 (existing flowtopgraphy, camera only sites and Verde Headwaters)





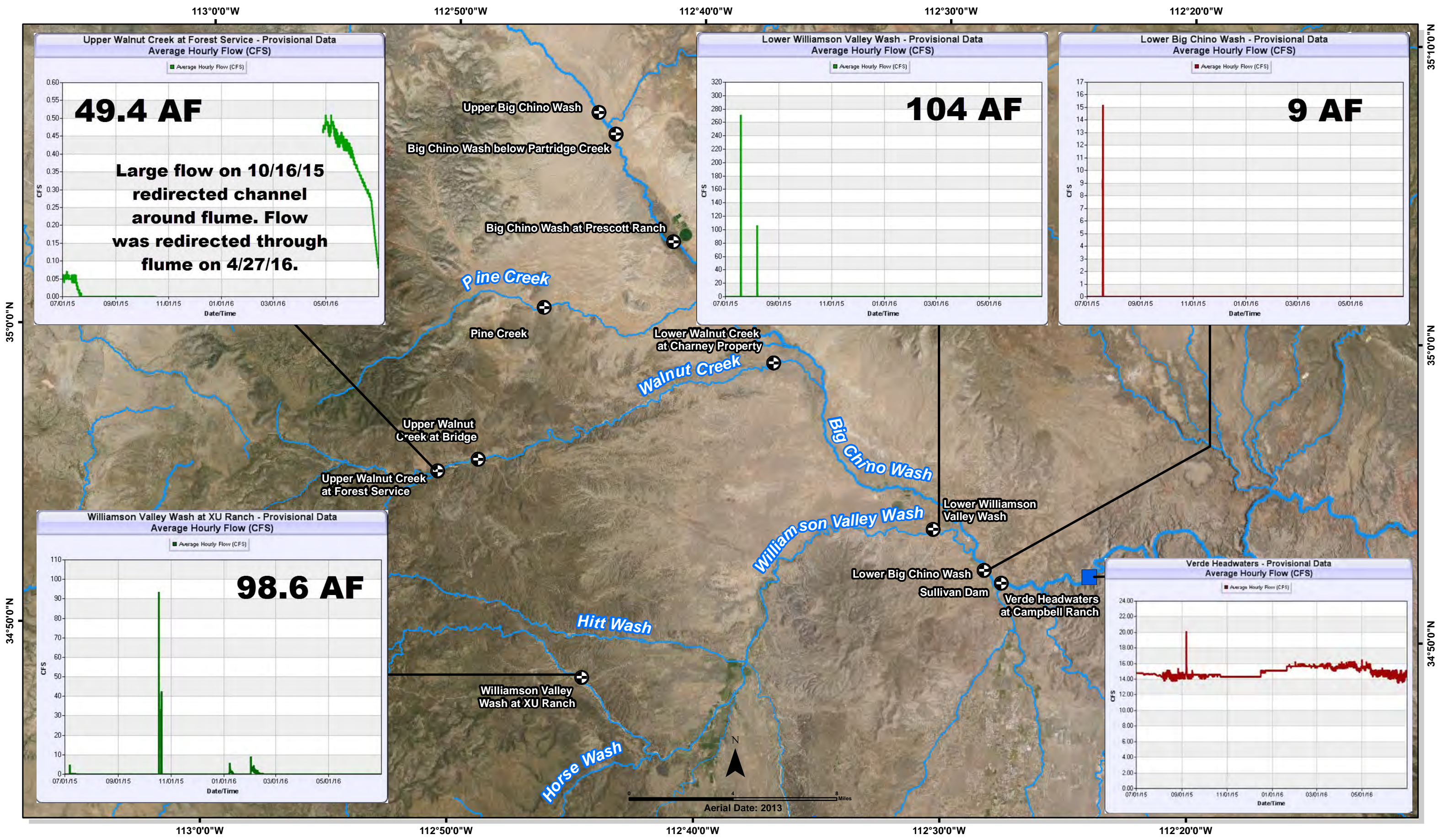
- Creeks & Washes
- Surface Water Monitoring Location
- Verde Headwaters

**Map 4**  
**Big Chino Sub-basin - Surface Water Monitoring**  
**Northern Hydrographs**

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

Map Courtesy of

bigchino\_wmsites\_16north.mxd 9/26/2016



**Map 5**  
**Big Chino Sub-basin - Surface Water Monitoring**  
**Southern Hydrographs**

- Creeks & Washes
- Surface Water Monitoring Location
- Verde Headwaters

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

Map Courtesy of

bigchino\_wmsites\_16south.mxd 9/26/2016



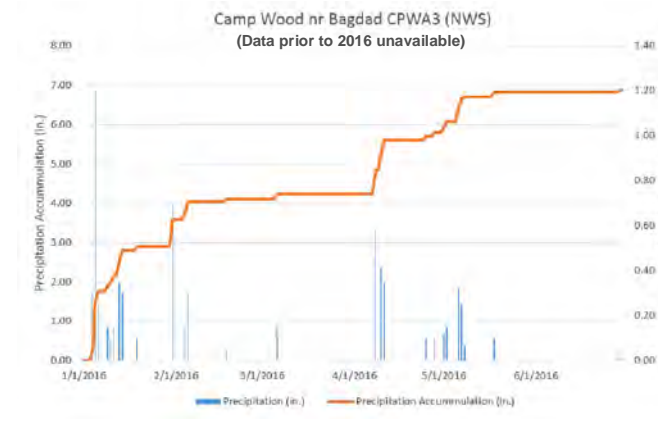
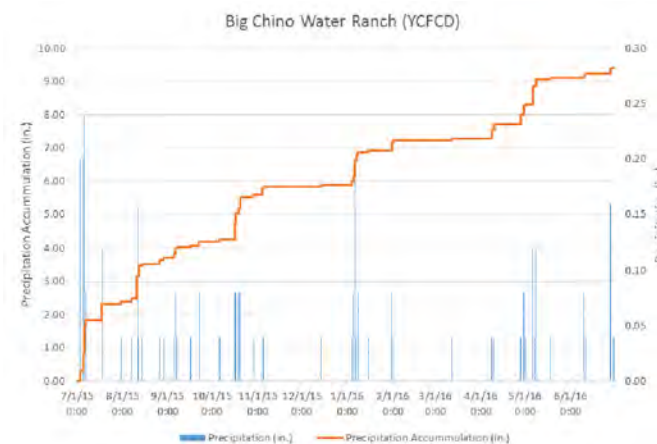
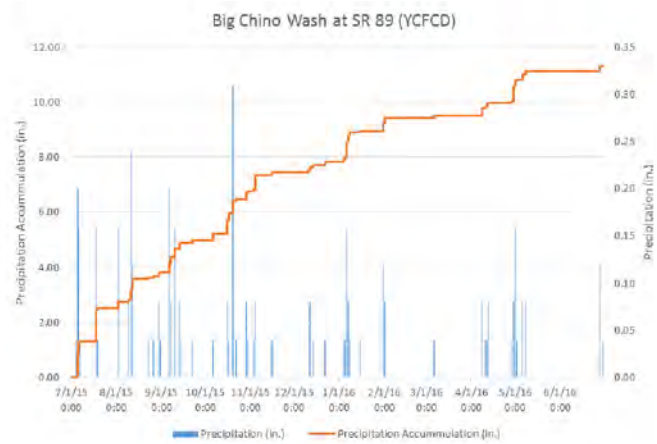
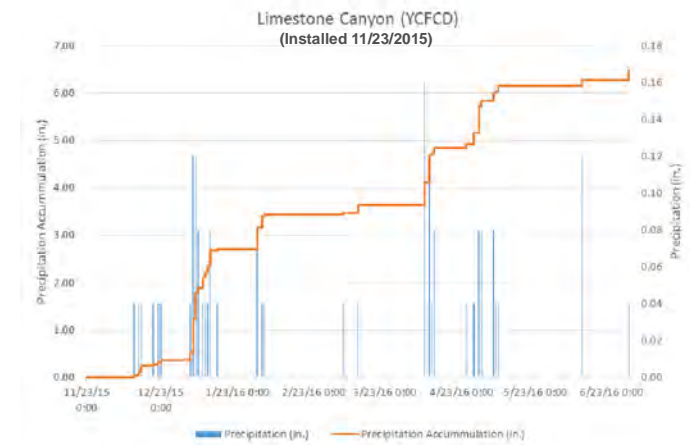
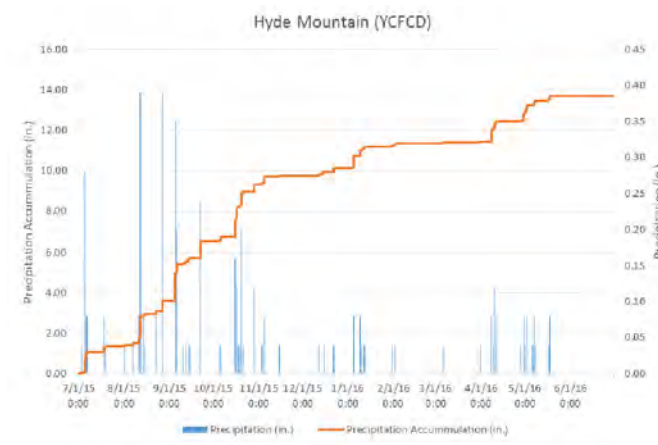
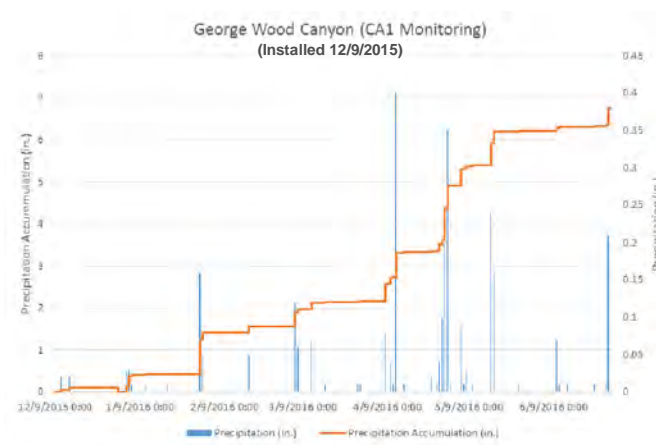
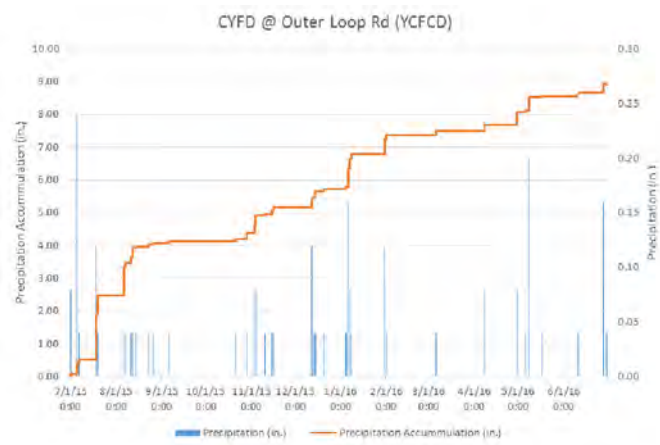
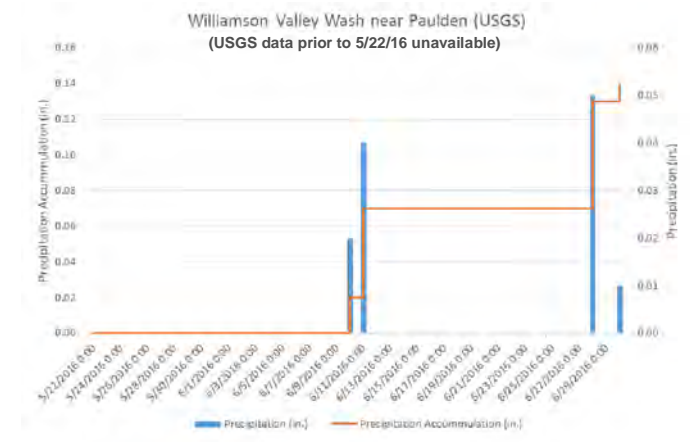
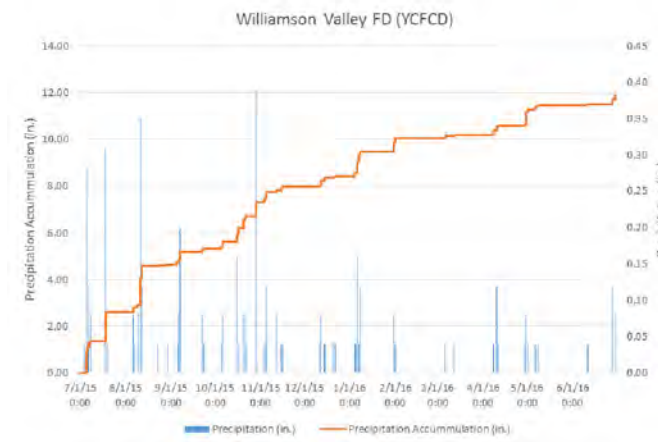
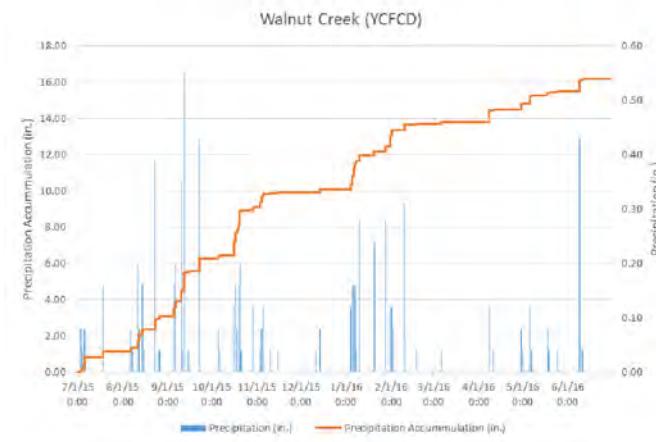
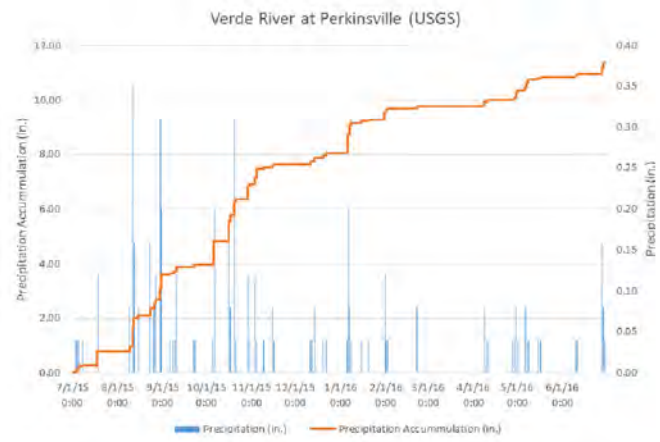
Aerial Date: 2013

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

**Map 6**  
**Big Chino Area**  
**Weather Stations**



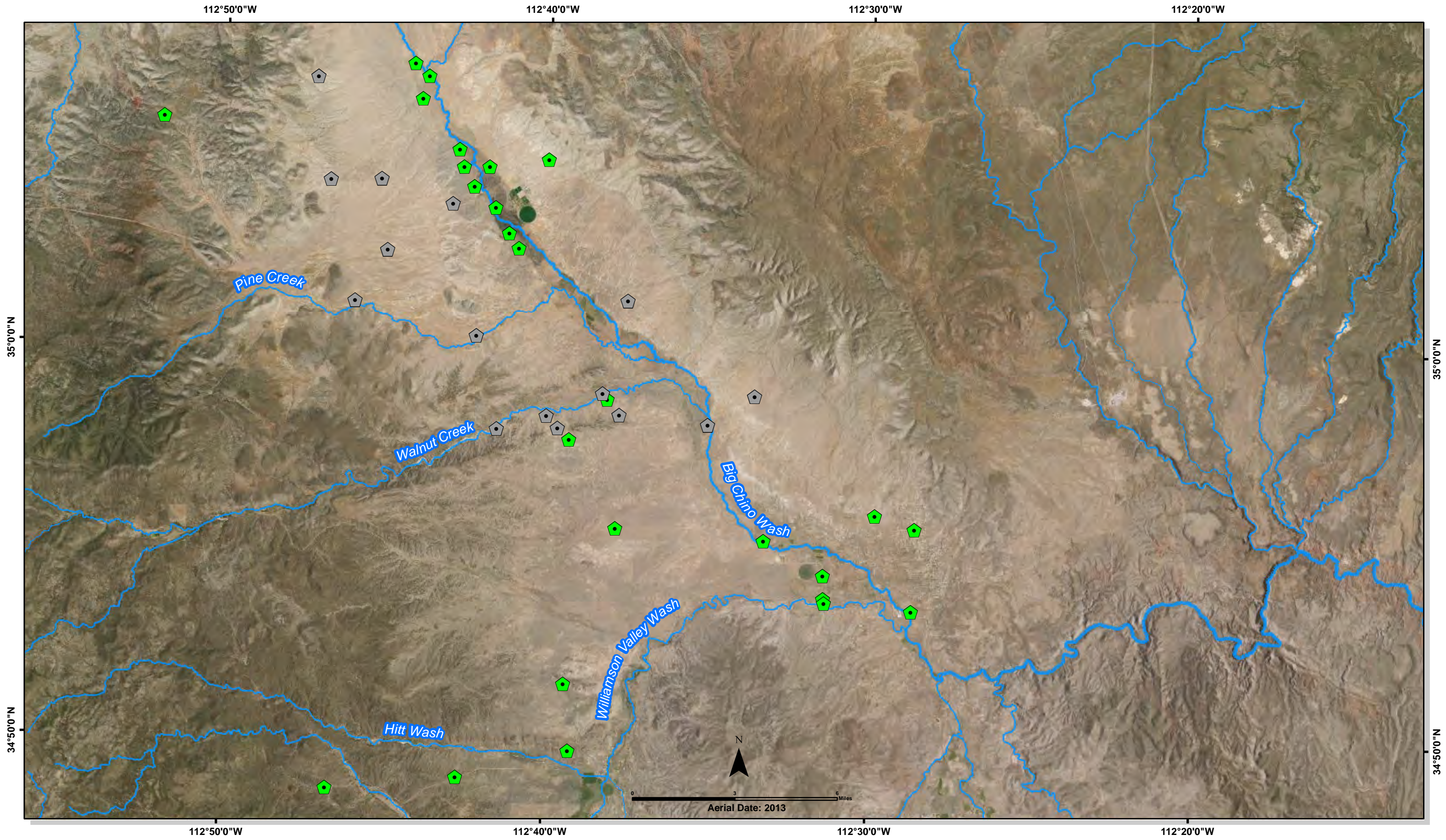
Map Courtesy of  
**SRP**  
 big\_chino\_weather\_stations16.mxd 9/26/2016



## Map 6a Big Chino Area Weather Station Data



Map Courtesy of  
big\_chino\_weather\_stations\_data16.mxd 9/22/2016



- USGS Gravity Sites**
- ▣ Existing Site
  - ▣ Potential Site

**Map 7**  
**Big Chino Sub-basin Water Monitoring Project**  
**USGS Gravity Sites**

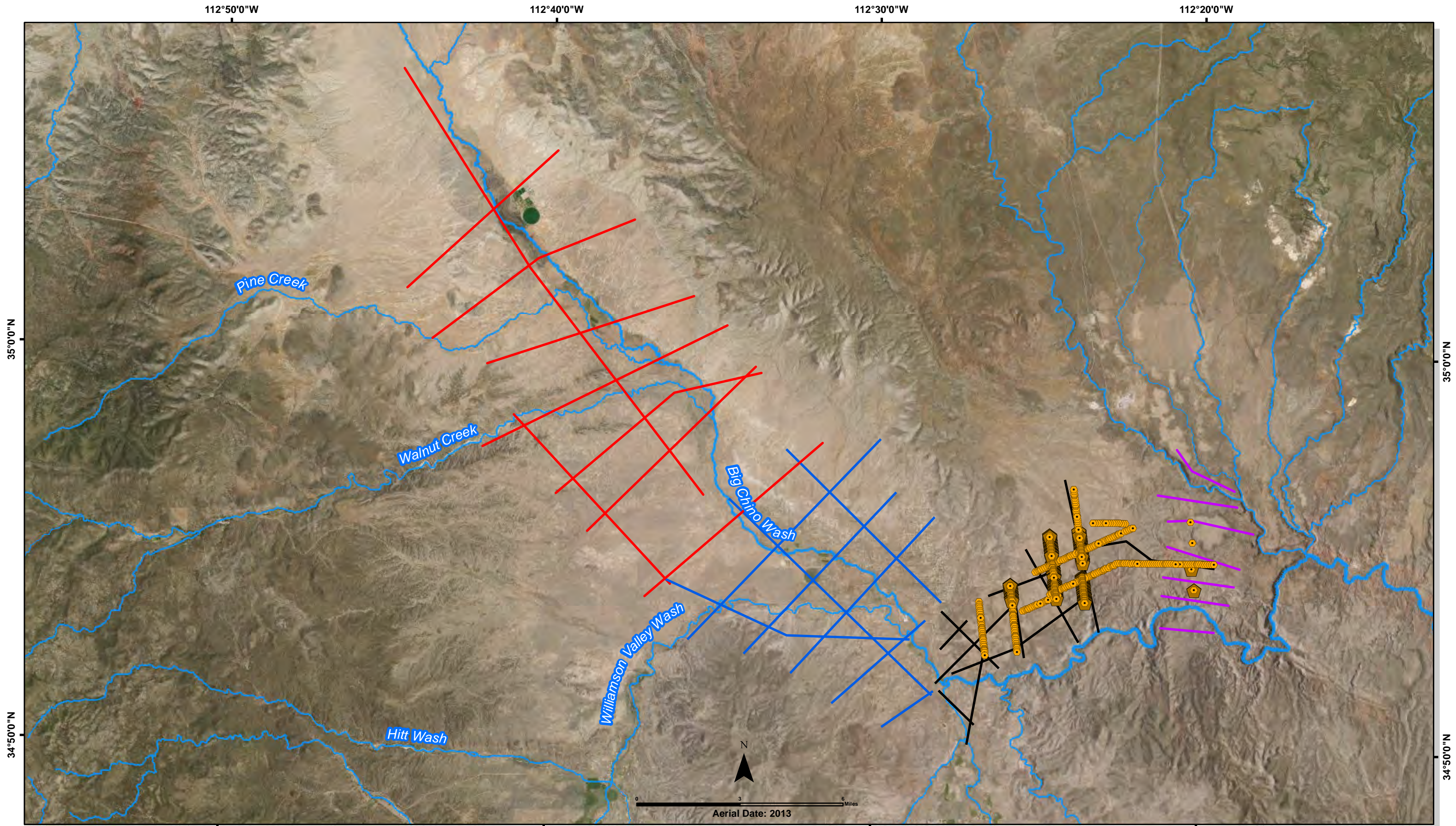


**BIG CHINO SUB-BASIN**  
**WATER MONITORING PROJECT**  
 PRESCOTT - PRESCOTT VALLEY - SRP



Map Courtesy of






bigchino\_gravity\_16.mxd 9/22/2016



**USGS Gravity Sites**

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

**Geophysical Profiles**

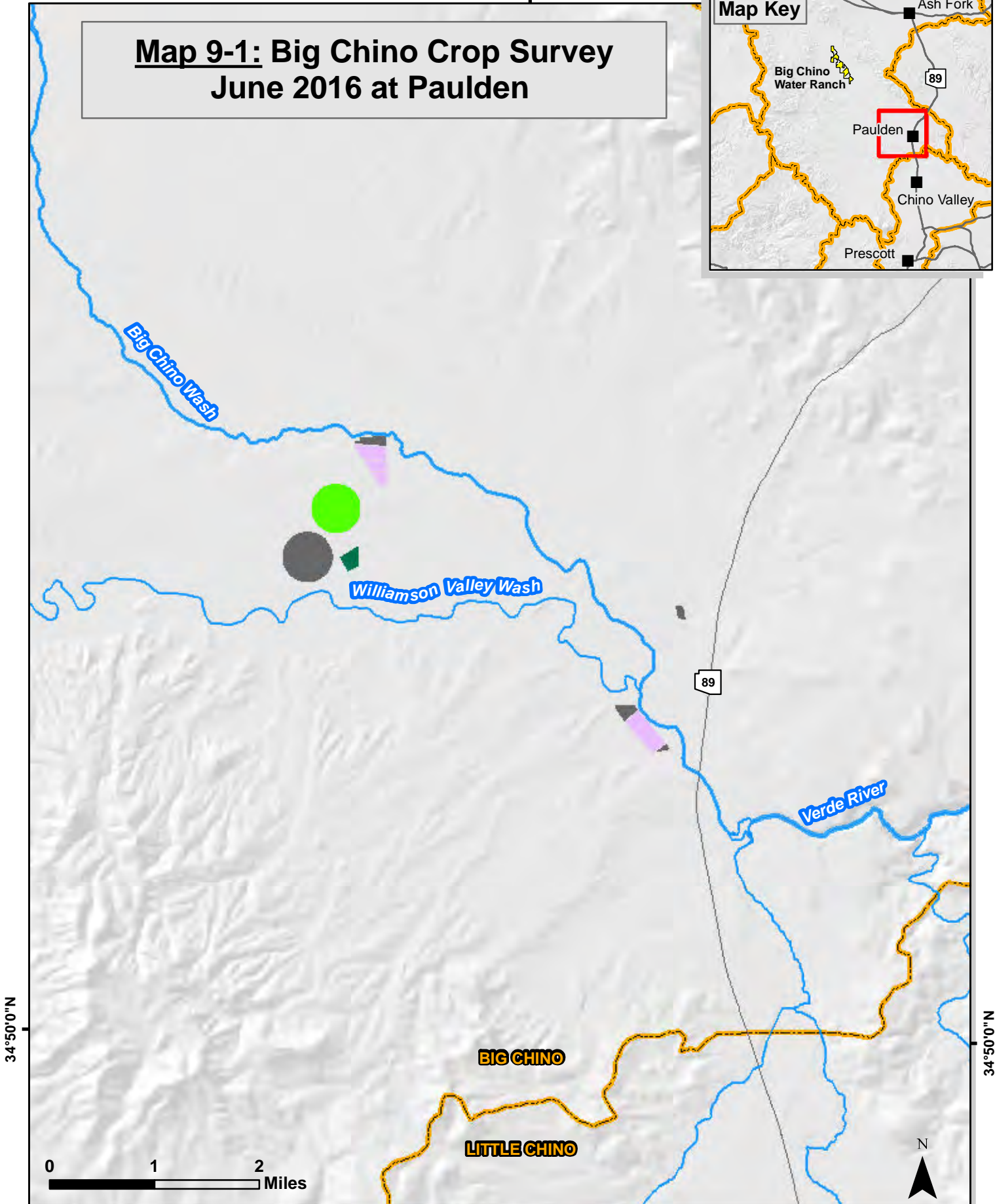
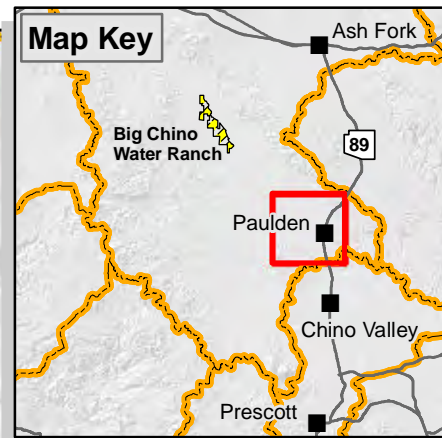
-  Phase 1
-  Phase 2
-  Phase 3
-  King Spring

**Map 8**  
**Big Chino Sub-basin Water Monitoring Project**  
**USGS Geophysical Profiles**



112°30'0"W

# Map 9-1: Big Chino Crop Survey June 2016 at Paulden



34°50'0"N

34°50'0"N

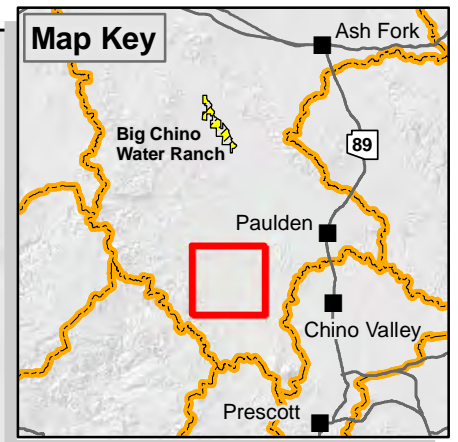
112°30'0"W

-  Oats
-  Corn
-  Timothy Grass
-  Barley-Wheat
-  Grass
-  No Crop Evident (Abandoned/Fallow)
-  Alfalfa
-  Sod
-  Groundwater Sub-basin (ADWR)



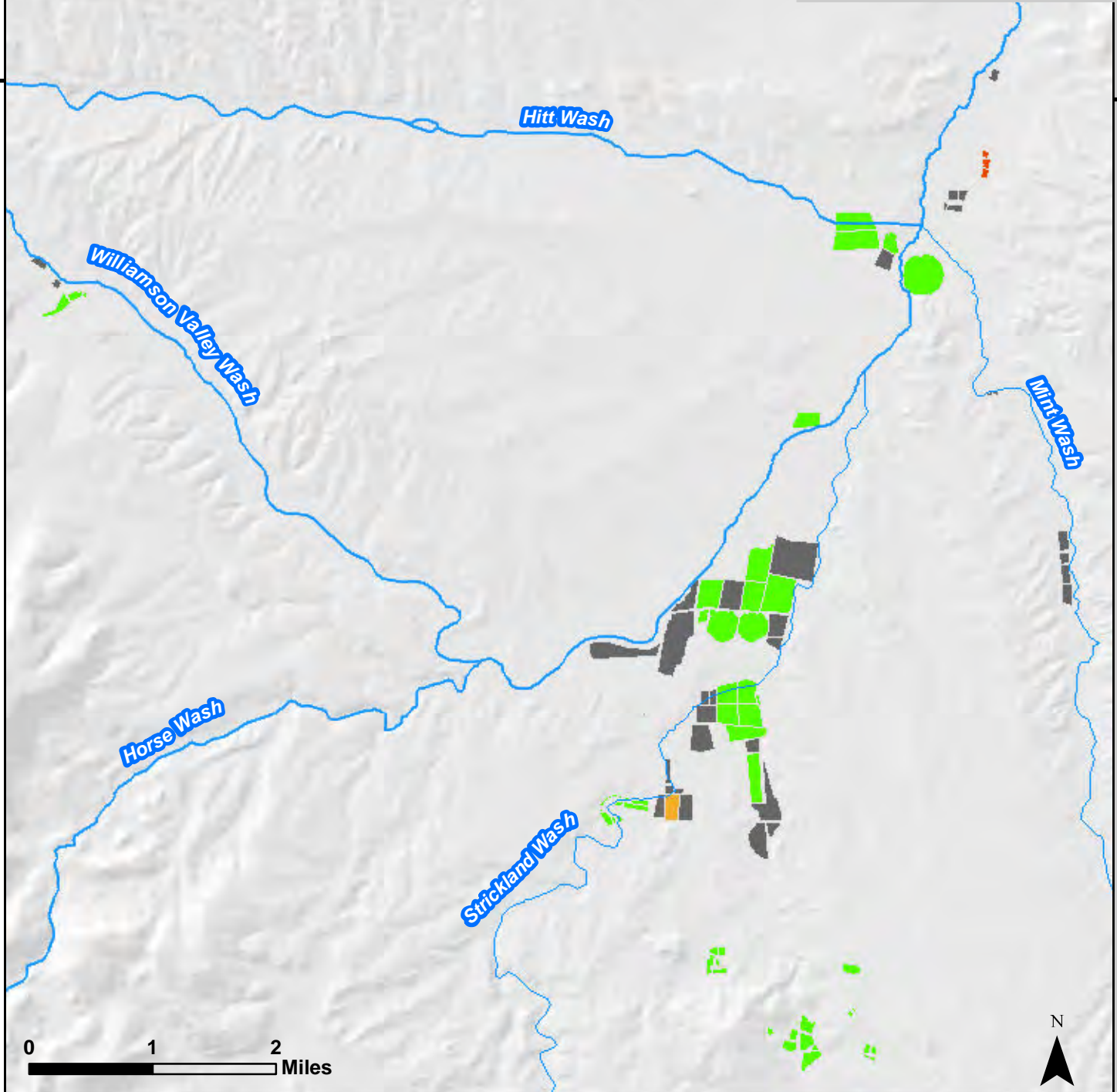
112°40'0"W

# Map 9-2: Big Chino Crop Survey June 2016 at Williamson Valley



34°50'0"N

34°50'0"N



112°40'0"W

- Oats
- Corn
- Timothy Grass
- Barley-Wheat
- Grass
- No Crop Evident (Abandoned/Fallow)
- Alfalfa
- Sod
- Groundwater Sub-basin (ADWR)

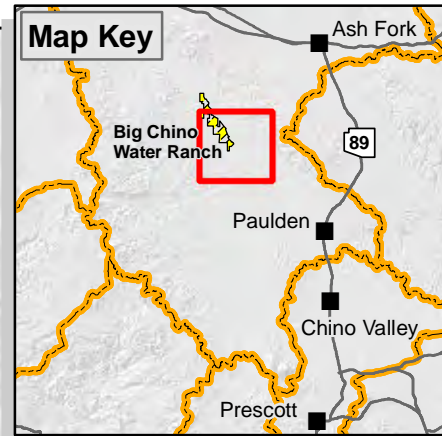


bigchino\_cropsurvey16.mxd 9/22/2016

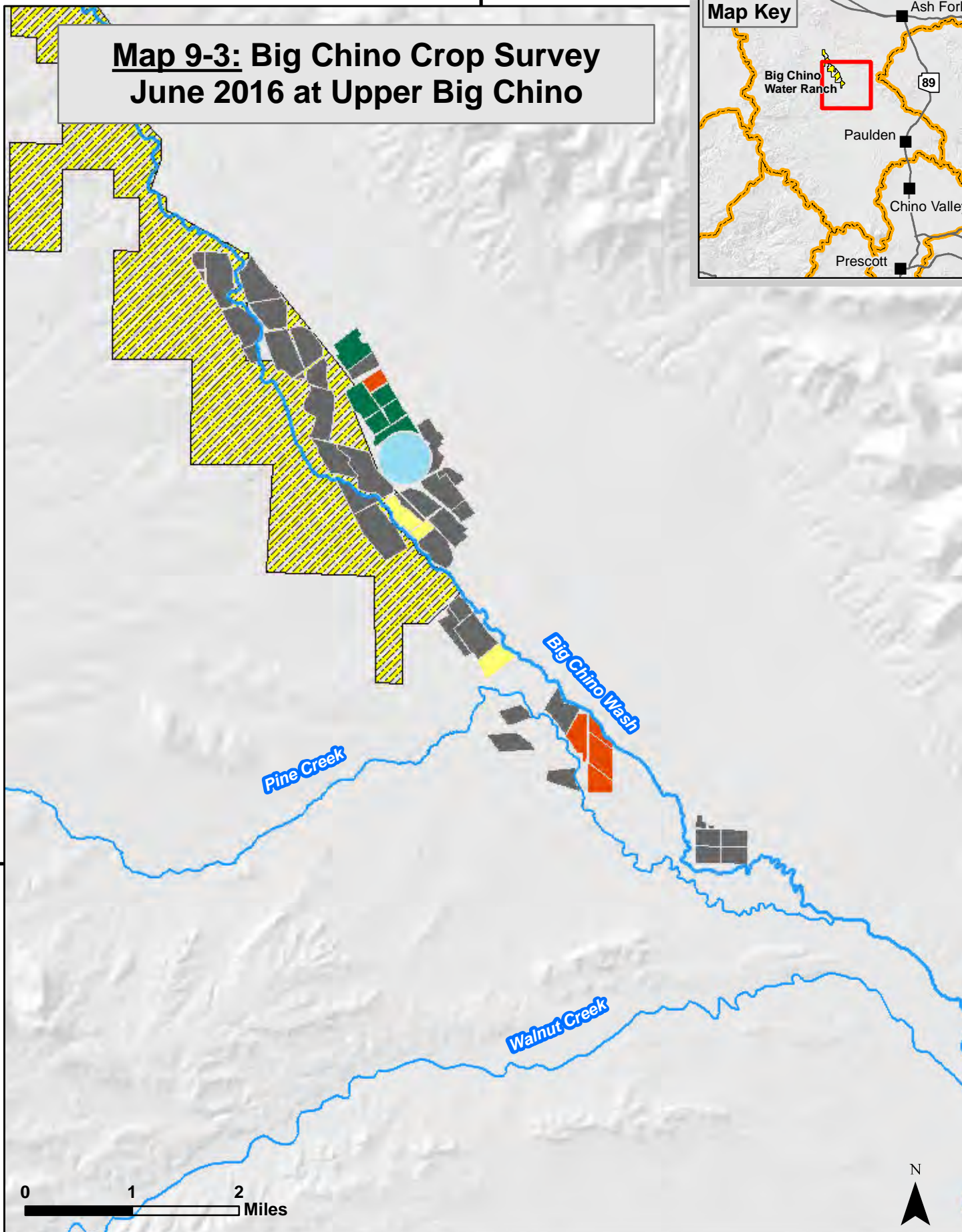


112°40'0"W

# Map 9-3: Big Chino Crop Survey June 2016 at Upper Big Chino



35°0'0"N



35°0'0"N

112°40'0"W

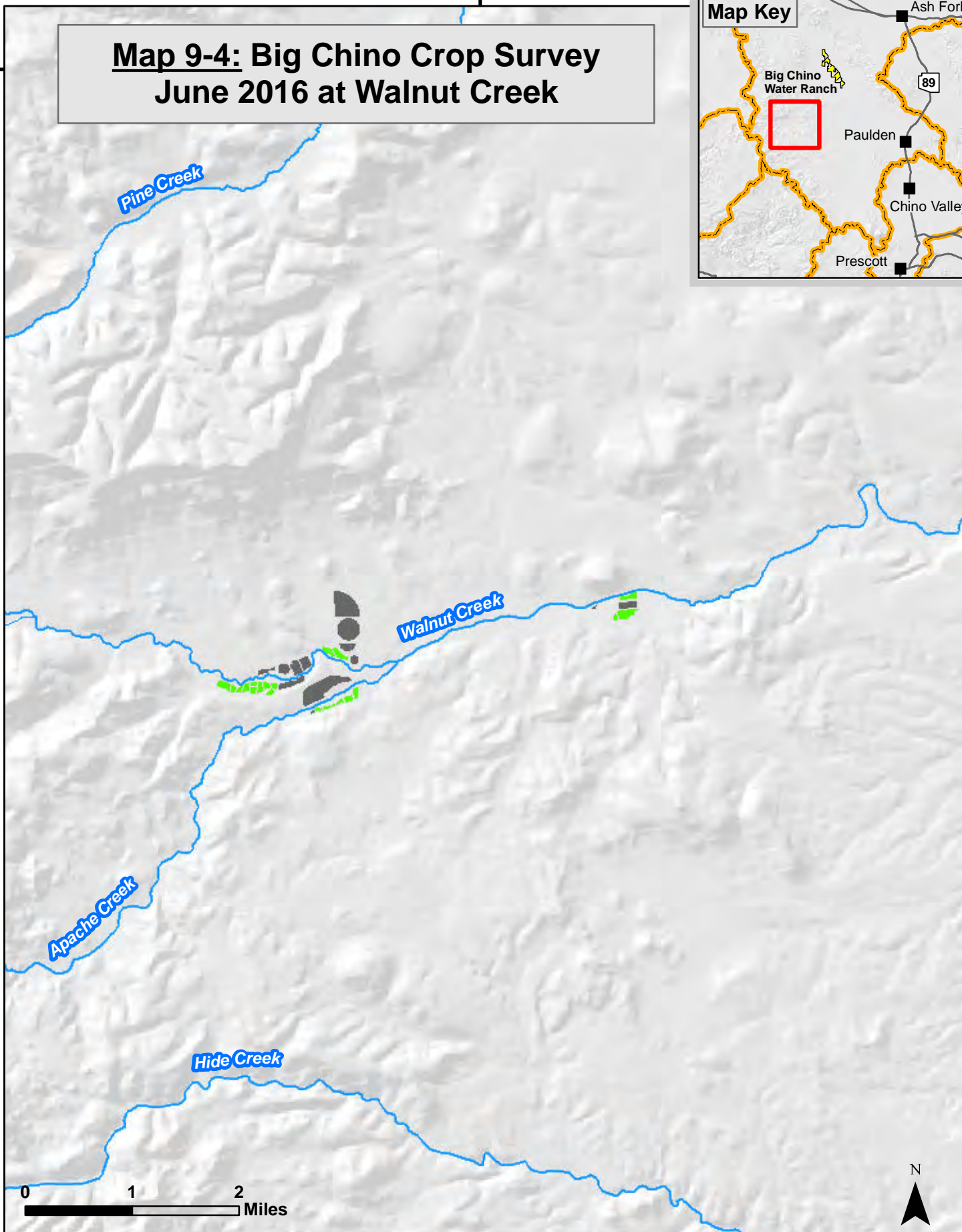
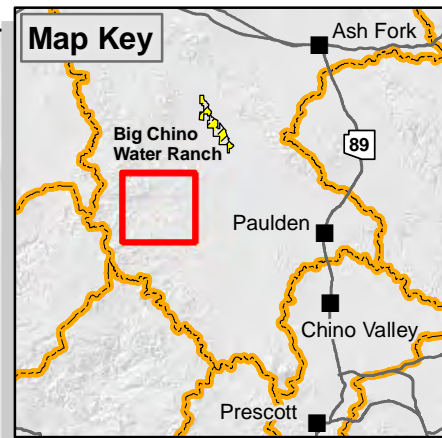
- Oats
- Corn
- Timothy Grass
- Barley-Wheat
- Grass
- No Crop Evident (Abandoned/Fallow)
- Alfalfa
- Sod
- Groundwater Sub-basin (ADWR)



112°50'0"W

35°0'0"N

# Map 9-4: Big Chino Crop Survey June 2016 at Walnut Creek



- |              |       |                                    |
|--------------|-------|------------------------------------|
| Oats         | Corn  | Timothy Grass                      |
| Barley-Wheat | Grass | No Crop Evident (Abandoned/Fallow) |
| Alfalfa      | Sod   | Groundwater Sub-basin (ADWR)       |

