



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Arizona Water Science Center
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Tucson, Arizona 85719

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<http://az.water.usgs.gov/>

April 23, 2015

6000000790/AZ006
Erin Young, Water Resources Manager
City of Flagstaff
211 W. Aspen Ave.
Flagstaff, AZ 86001

Dear Ms. Young:

Enclosed are two revised copies of our Joint Funding Agreement (JFA) to monitor the C Aquifer between Flagstaff and Winslow. The period of performance is October 1, 2014 through September 30, 2017; USGS fiscal years 2015, 2016 and 2017. The gross annual cost is \$17,500 and each year the USGS will contribute \$7,500 from the Cooperative Water Program and the City of Flagstaff will contribute \$10,000. Billing will be on a quarterly basis and the bills will be mailed in December, March, June and August. Work performed with funds from this agreement will be conducted on a fixed-price basis. The results of all work under this agreement will be available for publication by the USGS.

Please return a signed copy of the JFA to this office. If you have any questions, please contact Jamie Macy in our Flagstaff office at (928) 556-7276.

Sincerely,

James M. Leenhouts
Director

Enclosures (2)

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Customer #: 600000790/AZ006
Agreement #: 15WSAZ03100
Project #: ZF00C1D
TIN #: 86-6000244
Fixed Cost Agreement YES

JOINT FUNDING AGREEMENT

FOR
WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the, 23rd day of April, 2015 by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the CITY OF FLAGSTAFF, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation a program to monitor the C Aquifer as described in the attached work plan herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of \$0.00
 - (a) by the party of the first part during the period

Amount	Date	to	Date
\$22,500.00	October 1, 2014		September 30, 2017
 - (b) by the party of the second part during the period

Amount	Date	to	Date
\$30,000.00	October 1, 2014		September 30, 2017

Total = \$52,500

- (c) Contributions are provided by the party of the first part through other USGS regional or national programs, in the amount of:

Description of the USGS regional/national program:

- (d) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.
- (e) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.
- 3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
- 4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
- 5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
- 6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.

- 7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.
- 8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
- 9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered quarterly. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

**U.S. Geological Survey
United States
Department of the Interior**

CITY OF FLAGSTAFF

USGS Point of Contact

Customer Point of Contact

Name: James M. Leenhouts
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 520 N. Park Ave., #221
 Tucson, AZ 85719
 Telephone: 520-670-6671 x278
 Email: leenhout@usgs.gov

Name: Erin Young, Water Resources Manager
 Address: City of Flagstaff
 211 W. Aspen Ave.
 Flagstaff, AZ 86001
 Telephone: 928-213-2405
 Email: eyoung@flagstaffaz.gov

Signatures and Date

Signature: _____ Date: _____ Signature: _____ Date: _____

James M. Leenhouts 04/23/15

Name: James M. Leenhouts Title: Director
 Name: _____ Title: Mayor

Signature: _____ Date: _____ Signature: _____ Date: _____

Name: _____ Name: _____
 Title: _____ Title: City Clerk

Signature: _____ Date: _____ Signature: _____ Date: _____

Name: _____ Name: _____
 Title: _____ Title: City Attorney

A WORKPLAN FOR MONITORING THE C AQUIFER OF THE MIDDLE TO LOWER LITTLE COLORADO RIVER BASIN, ARIZONA

*-A cooperative program with the Bureau of Indian Affairs, the City of Flagstaff, and the U.S. Geological Survey-
Prepared by the U.S. Geological Survey Arizona Water Science Center*

INTRODUCTION: In 2005 the Bureau of Indian Affairs Navajo Region (Navajo-BIA) and the U.S. Geological Survey (USGS) established a cooperative groundwater-monitoring program for the C-aquifer near Flagstaff, Arizona that focuses on the middle to lower Little Colorado River Basin. In 2012 the City of Flagstaff joined the cooperative groundwater-monitoring program. The area of study specifically lies between Flagstaff and Winslow, Arizona where the greatest potential for groundwater development exists. The monitoring program was established at the request of Navajo- BIA and the Navajo and Hopi Tribes to develop a monitoring network that will help to understand the current baseflow conditions of the C aquifer in this area. The C aquifer is planned to be used by the tribes and the City of Flagstaff to meet future water-supply demands. From 2005-2012, funding support to monitor the C aquifer was provided by the Navajo-BIA and the USGS, and in 2012 the City of Flagstaff joined the cooperative effort. The City of Flagstaff recognizes the importance of monitoring this critical area and their continued participation in the monitoring effort is important to the ongoing monitoring project. Participation by the City of Flagstaff signifies an interest by the City to better understand groundwater resources in northern Arizona and a benefit of having the City as a funding partner in the monitoring program is that the USGS is able to provide cooperative funding to the program. The USGS can provide cooperative funding to non-federal partners such as the City of Flagstaff, but the USGS cannot contribute cooperative funds towards Navajo-BIA funding. Funding from the City of Flagstaff for the past three years has made it possible for the USGS to match the City's funding dollar for dollar. Another important benefit of funding from the City is that the Navajo-BIA informed the USGS that they may not be able to continue to financially support the program on an annual basis if there are no other funding partners involved. The City of Flagstaff's participation in the cooperative group monitoring the C aquifer is central to continuing this work for the next three year period and potentially longer.

The C-aquifer is a large regional aquifer system in the Little Colorado River Basin with potentially several hundred million acre-feet of water in storage (McGavock and others, 1986; Bills and others, 2000; and Bureau of Reclamation, 2006). The aquifer is used as a source of water for domestic, municipal, industrial, agricultural, and recreational water uses where the water quality is good. Groundwater withdrawals from the C-aquifer in the Little Colorado River Basin totaled about 140,100 acre-feet in 1995 (Hart and others, 2002).

This amount is a little less than half of the average annual, natural discharge from the basin of 319,000 acre-feet (Hart and others, 2002). Water demand mainly for municipal, industrial, and agricultural uses has resulted in significant drawdown of the potentiometric surface (the water table) in the central and upper parts of the basin.

Recent growth and development in Northern Arizona, especially by the City of Flagstaff, has resulted in the evaluation of the C-aquifer in the middle and lower parts of the Little Colorado River Basin as a possible source of water supply to meet future water demands. Several aquifer tests have been conducted in the Leupp area, along I-40 to the west of Winslow, and the area to the north of Moenkopi that indicated that the C-aquifer in these areas is likely to be very productive (Hoffmann and others, 2006; BOR, 2005; and Hopi Tribe, 2003). The Navajo Nation's groundwater resources of the C-aquifer in the Little Colorado River Basin are being affected by groundwater withdrawals for municipal, agriculture, and industrial water uses on the southwestern boundaries.

Proposed groundwater development from the C-aquifer include: 1) Future water supply for communities in the western and southern parts of the Navajo Indian Reservation, 2) The future source of municipal water supply for the City of Flagstaff (Red Gap Ranch), water supply for development along the I-40 corridor between Flagstaff and Winslow, and 3) water supply to support continuing development along the Little Colorado River Valley up gradient from Leupp. These future demands for groundwater resources in this area have the potential to affect groundwater withdrawals and the water quality in the basin, which may include a reduction to the base flow of perennial streams such as Clear Creek and Chevelon Creek (Leake and others, 2005; S.S. Papadopoulos and Associates, Inc., 2005), or further reduce the availability of water to the Little Colorado River and Little Colorado River alluvium which are already affected by existing upstream water uses. Additional development of groundwater resources from other water-bearing zones in this area could also occur to improve water supplies for communities in the western and southern parts of the Navajo Indian Reservation.

OBJECTIVE: The overall objective of the program is to establish current baseline information for the C-aquifer before significant additional groundwater development occurs in the Flagstaff to Winslow area, and to monitor for long-term changes in groundwater levels, water use, changes in baseflow in Clear and Chevelon Creeks, and water chemistry.

Groundwater resources of the C aquifer in the Little Colorado River Basin are already being affected by current withdrawals for municipal, agriculture, and industrial water uses throughout the upper and middle parts of the basin. Potential, additional groundwater withdrawals from the C aquifer, especially east of Flagstaff toward the Little Colorado River, could compound the effects of groundwater withdrawals in the

basin. The specific objectives of this monitoring program are:

- 1) Establish current baseline conditions in the C aquifer prior to significant additional groundwater development.
- 2) Collect and provide information on groundwater resources for the protection of native and endangered species that depend on the baseflow discharge from the C-aquifer to Clear and Chevelon Creeks.
- 3) Document changes in flow and water quality of the C-aquifer and adjacent water-bearing zones that may impact the use of these water resources.
- 4) Inventory and characterize spring resources at the southwestern boundaries of the Navajo reservation.

PROJECT DESCRIPTION/SCOPE OF WORK:

Methodology

The USGS proposes to continue operation and maintenance of a core monitoring network of selected wells and sampling sites during a 3 year cooperative agreement. The C aquifer program work plan is dependent on funding from cooperators. If the full funding cooperation is not met, then the work plan is revised to include those tasks that can be funded at the available funding level. The monitoring network includes:

1. Five continuous-record observations wells, with satellite telemetry and quarterly check measurements and additional maintenance as needed (table 1). Real-time data are available from these sites at:

<http://waterdata.usgs.gov/az/nwis/current/?type=gw>

2. Produce a daily values water-level record for these five sites for the current water year.
3. Measurement of quarterly water levels by the USGS at 11 observation wells located in the C aquifer between Flagstaff and Winslow, AZ (table 2). Also includes C aquifer well data provided by the City of Flagstaff and Arizona Department of Water Resources as part of this water-level network (figure 2).
4. Conduct a base flow evaluation during the current year consisting of up to 12 sites on Clear Creek, Chevelon Creek, and on the Little Colorado River from Chevelon Creek to Clear Creek for comparison to the base-flow evaluations conducted in summers 2005, 2006, 2008, 2012 and winter 2010.
5. Collect discharge and water quality field parameters (specific conductance, pH, water temperature, and dissolved oxygen) quarterly for two to four springs (Artesian Spring on Clear Creek below Mc Hood Reservoir, Seba Dalkai Springs, Coyote Springs near Dilkon, and Shonto Spring near Dilkon) to continue to document and characterize the quantity and quality of water resources at the western end of the Navajo Reservation in the current year.
6. Work with other Federal, Tribal, State, and local partners to develop additional financial support for this study or with in-kind services, so that partners can be included as cost-sharing efforts.
7. When funds are available, publish the next in a series of USGS Open-File report that will summarize and evaluate the study data collected from 2012 to 2015. The report will be published in FY2016 if funding is available.

DELIVERABLES: The following deliverables will be provided to all cooperators based on the field data collected and on the above methodology. The City of Flagstaff will be provided provisional data for their review as it becomes available during the project, and also courtesy review copies of planned reports that will be published by the USGS.

1. The USGS will publish a USGS digital Open-File data report dependent on funding. The current work plan does not include funding for a USGS data report, but if funding were to become available, then a USGS report would be added.
2. The USGS will publish on-line all data collected for the program with corresponding USGS site numbers on the USGS NWIS Web (table 1 and 2). <http://waterdata.usgs.gov/az/nwis/gw>
3. Copies of publications or reports that USGS presents at conferences or meetings.

TASK / BUDGET/TIME LINE FY15

1. Project oversight.		\$33,000
4 month		
Labor (1 hydrologist, 1 hydrologic technician)	\$32,000	
Travel	\$ 1,000	
2. Maintenance, operation and processing of 5 continuously monitored observation wells with telemetry (table 1 and fig.1; about \$3,000 per well).		\$15,000
4 months		
Labor (1 hydrologic technician)	\$13,000	
Travel	\$ 1,275	
Supplies	\$ 725	
3. Quarterly water-level measurements at observation wells (table 2 and fig.2).		\$2,500
4 months		
Labor (1 hydrologic technician)	\$ 1,780	
Travel	\$ 480	
Supplies	\$ 240	
4. Conduct a base flow evaluation consisting of 24 sites on Clear Creek, Chevelon Creek, and on the Little Colorado River from Chevelon Creek to Clear Creek		
1 month		\$12,000
Labor (one Hydrologist, 3 hydrologic technicians)	\$8,000	
Travel	\$1,800	
Supplies	\$2,200	
5. Funds to carry over to FY2016		<u>\$30,000</u>
FY15 Total Program costs		\$92,500

Cost Sharing:

<u>Other Federal Agency (OFA) Program</u>	<u>Amount</u>
Bureau of Indian Affairs (BIA), Navajo Area Office (carried over from FY14)	\$25,000
Bureau of Indian Affairs (BIA), Navajo Area Office (FY15 request)	\$50,000
City of Flagstaff (FY15)	\$10,000
U.S. Geological Survey (USGS Department of the Interior cost share)	<u>\$7,500</u>

FY15 Total Program costs **\$92,500**

FUNDING BY YEAR			
	FY15	FY16	FY17
BIA Navajo Area Office	\$50,000	\$50,000	\$50,000
City of Flagstaff	\$10,000	\$10,000	\$10,000
USGS	\$7,500	\$7,500	\$7,500

PAST ACCOMPLISHMENTS**1997-2005**

Groundwater monitoring network supported by the National Park Service

2005

USGS and BIA establish current monitoring program

BIA primary funding partner, NPS no longer funding partner

Establish network of 24 quarterly observation wells

1st Base-flow evaluation of Chevelon Creek, Clear Creek, and part of the Little Colorado River

2006

3 USGS streamflow gaging stations established on Chevelon and Clear Creek

5 Continuous recording, telemetered observation wells instrumented near Leupp and Winslow, AZ

2nd Base-flow evaluation of Chevelon Creek, Clear Creek, and part of the Little Colorado River

2007

Program discontinued due to lack of funding

2008

Program re-established with BIA funding and ADWR in-kind support

3rd Base-flow evaluation of Chevelon Creek, Clear Creek, and part of the Little Colorado River

2010

4th Base-flow evaluation (1st winter evaluation)

2011-12

USGS publication describing C aquifer results from 2005-2011

2012

City of Flagstaff joins the cooperative monitoring program

5th and 6th Base-flow evaluations

Continuous water-level data from 5 continuous recording telemetered observation wells (table 1)

Discrete water-level measurements at wells listed on table 2

Water-quality field parameters and discharge measurements at springs listed on table 3

Updates from water-level measurements made by ADWR (fig. 2)

HISTORY OF FUNDING FOR THE C AQUIFER PROJECT

C Aquifer Project	BIA Navajo	National Park Service	US Geological Survey	Arizona Dept. Water Resources	City of Flagstaff
FY 1997		\$15,000			
FY 1998		\$15,000			
FY 1999		\$15,000			
FY 2000		\$15,000			
FY 2001		\$17,510			
FY 2002		\$17,510			
FY 2003		\$38,000			
FY 2004		\$18,000			
FY 2005	\$234,000				
FY 2006	\$278,840		\$3,860		
FY 2007			*\$25,000		
FY 2008	\$50,000				
FY 2009	\$57,197		\$10,149		
FY 2010	\$60,000			*\$4,400	
FY 2011	\$84,212		\$13,600	*\$4,400	
FY 2012	\$50,000		\$10,000	*\$4,500	\$10,000
FY 2013	\$50,000		\$10,000	*\$4,500	\$10,000
FY 2014	\$25,000		\$7,500	*\$4,600	\$10,000

*In-kind services

Table 1. Observation wells with satellite telemetry and quarterly check measurements.

Site Name	Site ID	Station Number
OW-1	351022111061801	05 145-05.92X05.31
OW-2B	351214111022101	05 145-02.25X03.18
OW-3A shallow	350959110562303	05 144-10.70X05.71(2)
Winslow T	345603110450301	(A18-15) 28aad
Winslow I-40	350002110355501	(A-19-16) 36dbb

Table 2. Quarterly observation wells measured by the USGS

Site number	Site name	Site ID	Well owner
A-20-12H13CBB	Sunshine Well	350706111014701	Hopi
--	BOR-OW-2A, shallow	351216111021902	Navajo
--	BOR-OW-2A, middle	351216111021903	Navajo
--	BOR-OW-2A, deep	351216111021904	Navajo
--	BOR-PW-2B	351213111022101	Navajo
--	BOR-PW-2A	351218111021701	Navajo
--	BOR-PW-1A	351023111062002	Navajo
A-21-07 24AAD	Foxglenn	351127111360001	Flagstaff
A-21-08 17BCA2	Continental 2	351224111342601	Flagstaff
A-20-08 18BCC	Lake Mary 2	350700111354701	Flagstaff

Table 3. Springs to measure and sample for flow and groundwater field parameters.

A-18-16 10CDC	Clear Creek artesian spring	345813110382701
To be determined	Coyote spring near Seba Delkai	to be determined
To be determined	Seba Delkai, spring	353002110364001
To be determined	Shonto spring	to be determined

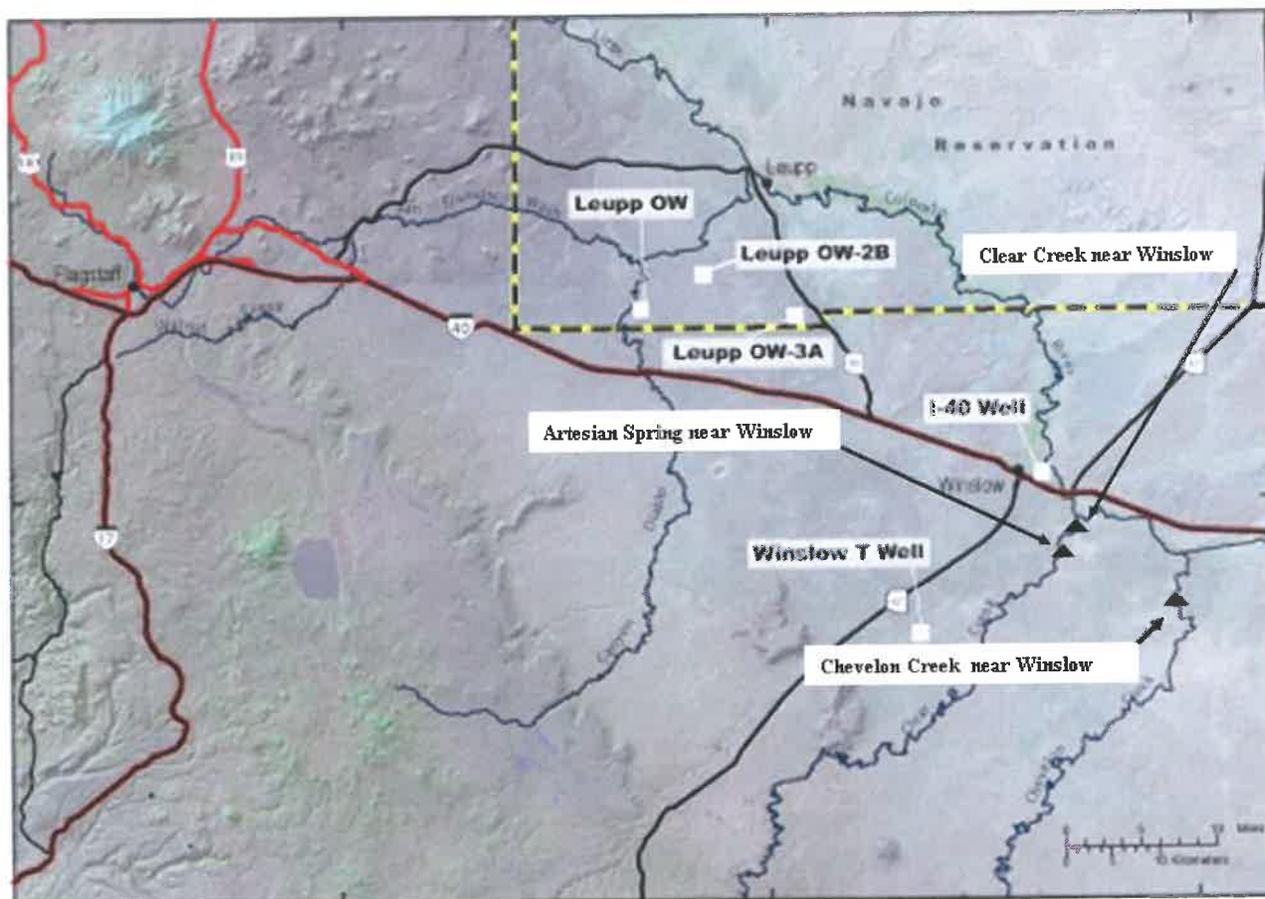


Figure 1. Location of stream-flow gages and monitoring wells, C aquifer monitoring program, Little Colorado River Basin, Arizona.

Site Name	Site ID	Station Number	Data collected by
OW-1	351022111061801	05 145-05.92X05.31	USGS
OW-2B	351214111022101	05 145-02.25X03.18	USGS
OW-3A shallow	350959110562303	05 144-10.70X05.71(2)	USGS
Winslow T	345603110450301	(A18-15) 28aad	USGS
Winslow I-40	350002110355501	(A-19-16) 36dbb	USGS
Clear Creek near Winslow (discontinued, 2007)	09399000	--	--
Artesian Spring near Winslow (Discontinued, 2007)	09399100	--	--
Chevelon Creek near Winslow (Discontinued, 2007)	09398000	--	--

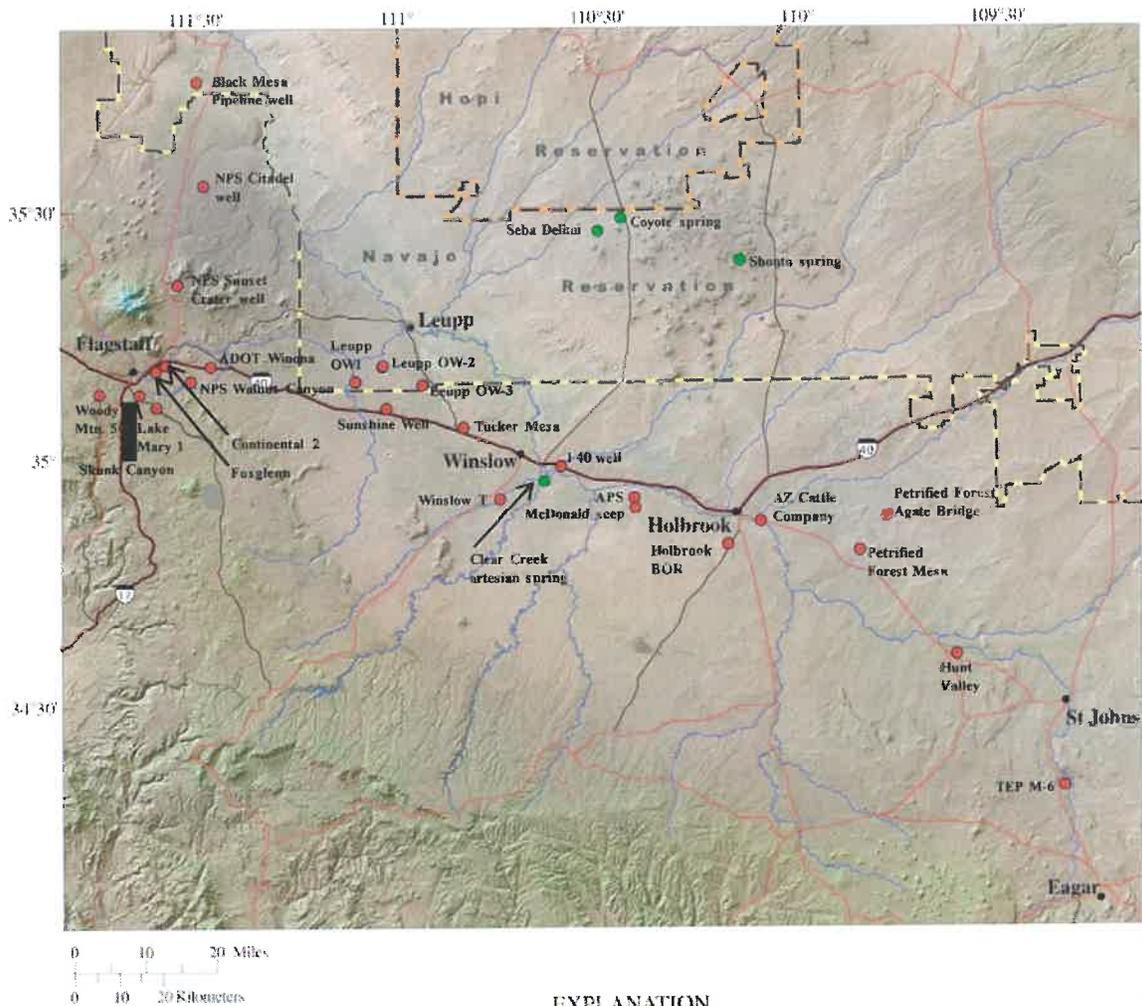


Figure 2. USGS and ADWR quarterly monitoring wells and springs, C aquifer monitoring network, Little Colorado River Basin, Arizona

Site number	Site name	Site ID	Data Collected by
Wells			
A-20-12H13CBB	Sunshine Well	350706111014701	USGS
A-18-15 28AAD	Winslow T	345603110450301	USGS
A-19-16 36DBB	Winslow I-40	350002110355501	USGS
A-17-21 10CBA	AZ Cattle Company	345310110062501	ADWR
A-17-23 35DDA	Petrified Forest Mesa	344928109515301	ADWR

A-17-24 09ABD	Petrified Forest Agate Bridge	345333109474501	ADWR
05 145-05.92X05.31	Leupp OW-1	351022111061801	USGS
05 145-02.25X03.18	Leupp OW-2	351214111022101	USGS
05 144-10.70X05.71(2)	Leupp OW-3	350959110562303	USGS
A-20-07 03ACA	Skunk Canyon	350848110381701	ADWR
A-21-08 26DAB	NPS Walnut Canyon	351025111303701	ADWR
A-25-09 06CCD	NPS Citadel	353410111284001	ADWR
A-23-08 21ABA	NPS Sunset Crater	352214111324601	ADWR
A-21-07 24AAD	Foxglenn	351127111360001	City of Flagstaff
A-21-08 17BCA2	Continental 2	351224111342601	City of Flagstaff
A-20-08 18BBB	Lake Mary 1	350716111354401	City of Flagstaff
A-20-06 02BBB	Woody Mountain 5	350856111441601	City of Flagstaff
A-21-09 17ACD	ADOT Winona	351213111274001	ADWR
A-19-14 03AAC1	Tucker Mesa	350446110502501	ADWR
A-18-18 34DAA2	McDonald, seep	345454110245201	ADWR
A-18-18 27AAB	APS	345608110250001	ADWR
Springs			
A-18-16 10CDC	Clear Creek artesian spring	345813110382701	USGS
	Coyote spring	352447110085901	--
	Seba Delkai	353002110364001	USGS
	Shonto spring	352829110300601	--