

# Leroux Redux\*: Release of Flow at Big Leroux Spring near Flagstaff, Arizona

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\* Redux is an adjective, meaning "brought back" or "resurgent".

## Abstract

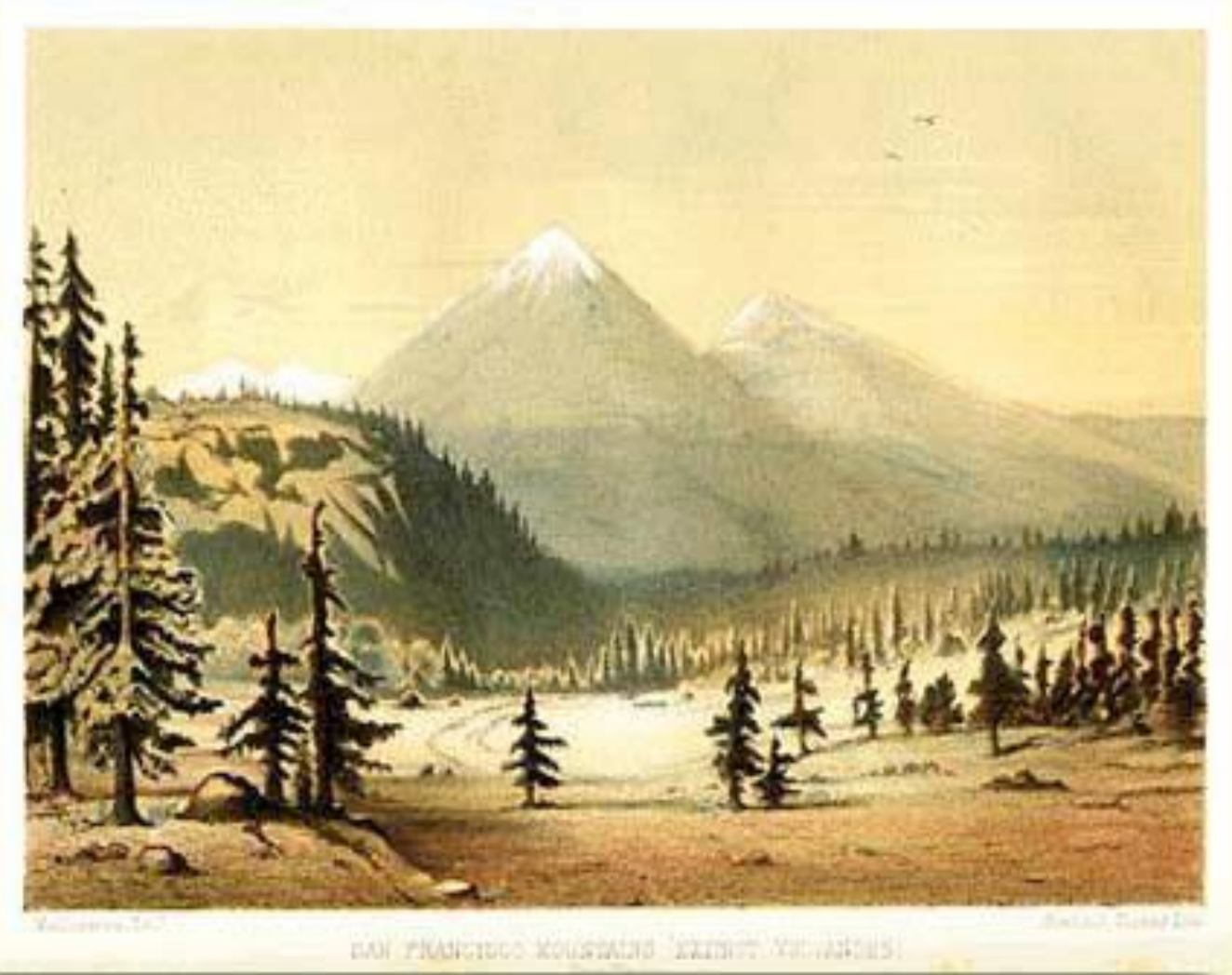
Big and Little Leroux Springs are located in volcanic terrain near the base of the San Francisco Peaks about 10 miles northwest of Flagstaff and are the perennial surface headwaters of Flagstaff's Rio de Flag watercourse. These springs were important to Native Americans, and played a critical role as a source of water for explorers and settlers in the Flagstaff region.

One of the those early explorers described Big Leroux Spring as "...of transparent sparkling water, and bursts out of the side of the mountain and runs gurgling down for a quarter of a mile, where it loses itself in the valley." Flagstaff historian Platt Cline called it "the finest spring at the foot of the San Francisco Peaks." Yet for decades a series of spring boxes and underground pipes have prevented the natural flow from reaching the surface.

In recent years, need for water from the spring has diminished, opening the opportunity for release of flow and ecological restoration of the site. Friends of the Rio de Flag proposed that as part of the Wing Mountain Fuels Reduction and Forest Health Restoration Project surface flow to Big Leroux Spring be restored. In February 2013 Coconino National Forest Supervisor Earl Stewart signed the Decision Notice and Finding of No Significant Impact for the Proposed Action that includes a "desired condition of healthy, self-sustaining riparian vegetation for Big Leroux Spring." On June 30, 2013 valves were opened, releasing flow of Big Leroux Spring once again.

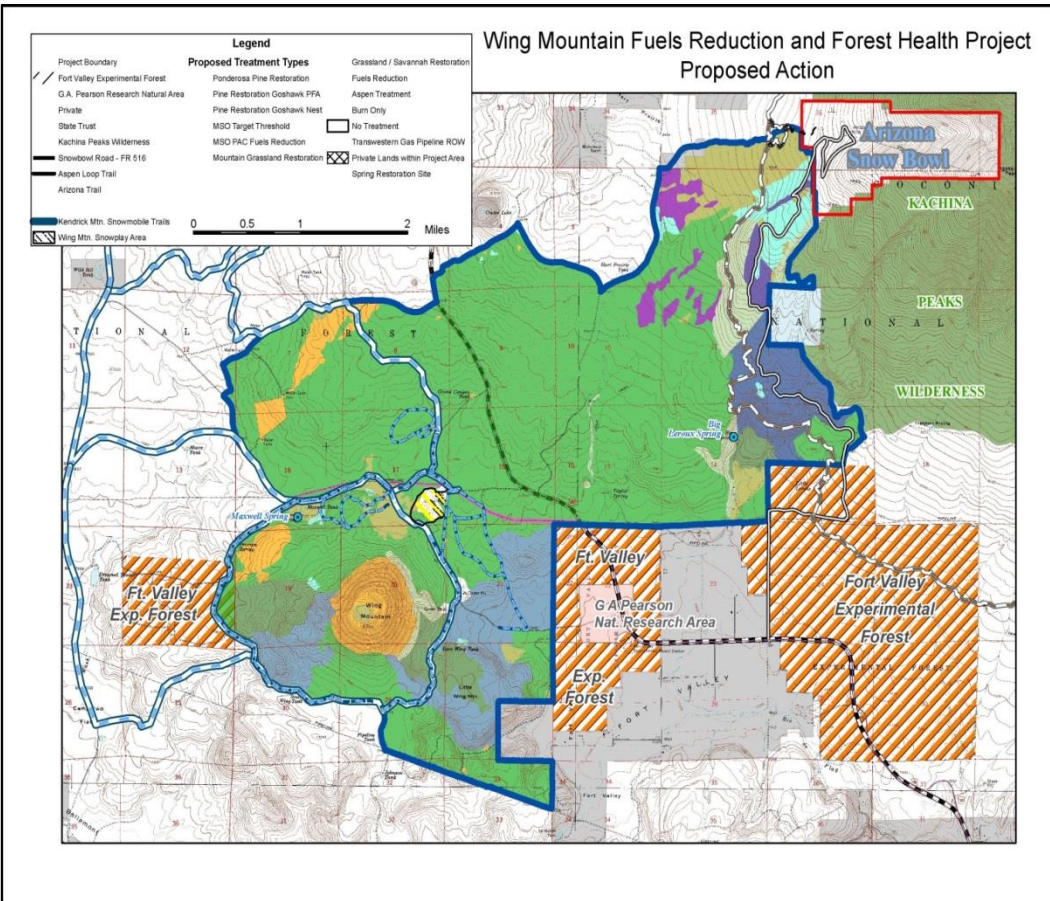
## History and background

Big Leroux Spring was "discovered" in 1851 by the Sitgreaves Expedition, which was guided by Antoine Leroux. The spring and its small riparian area became a vital oasis for all subsequent expeditions through the region, and Fort Moroni, now Fort Valley, was the first substantial settlement in the Flagstaff area.



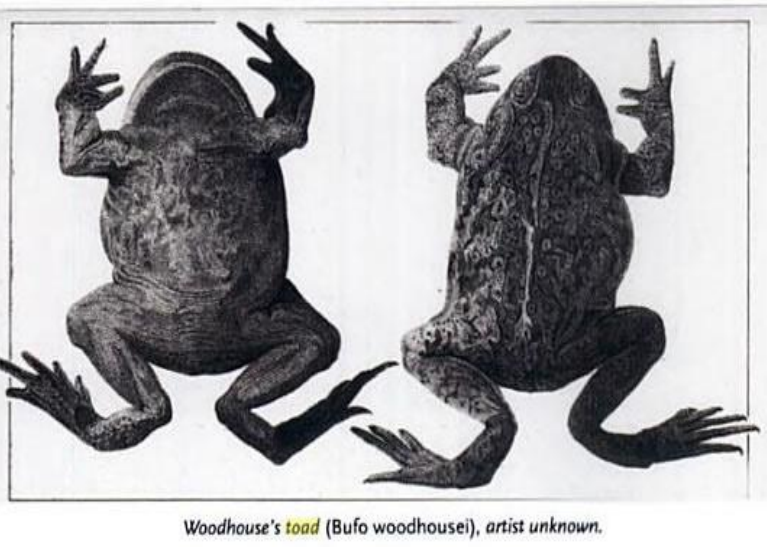
Lt. Edward Beale, who made four journeys through the area, had the highest regard for Antoine Leroux, and the Beale Road was carefully routed near Leroux Springs. Flagstaff historian Platt Cline wrote: "Leroux could be described as father, perhaps grandfather, of Flagstaff, because he was the first to become intimately acquainted with the area, and it was on his advice that the expeditions followed the general routing through here which they did." (Cline, p. 18). Water was scarce at times in the growing city of Flagstaff, and at least as early as 1881 water was hauled from Leroux Springs in barrels on an oxen-pulled wagon.

The abundance and reliability of Leroux Springs water caused farming to gradually replace ranching in Fort Valley in spite of the short growing season. By the early twentieth century homesteaders were plowing under the native grasses and planting crops. Root crops were preferred since they are not as susceptible to the frosts and high winds. Potatoes, in particular, were grown successfully for several decades (Olberding, p. 46). By 1923, Big Leroux Spring was used exclusively for farming at the homestead in the meadow below the spring; Buck Taylor built the first onsite residence and barn about that time. Subsequent owners of the property continued farming at this site for the next two decades and provided water to local residents during dry years. Farming ended in 1948 when Al Grasmoe, Arizona Snowbowl owner, acquired the site and named it Ski and Spur Ranch. Ski clubs and a girls' summer camp used the residences in the 1950s. The US Forest Service obtained the site and water rights in 1971 and currently uses it for firefighter operations. The Fort Valley Experimental Forest received a water right for Little Leroux Spring in 1933. The Civilian Conservation Corps soon built a storage tank and 2.5 mile pipeline to the station in Ft. Valley and for irrigating a nearby nursery. In 1972 the Big and Little Leroux water systems were connected together to take advantage of Big Leroux's higher flows and Little Leroux's storage tank.



Accompanying the Sitgreaves expedition was Surgeon-Naturalist S. W. Woodhouse. In the vicinity of Big Leroux Spring he collected two previously undescribed mammals, *Sciurus aberti*, (Abert's squirrel), and *Geomys fulvus*, later reclassified as *Thomomys bottae fulvus*, the western or pygmy pocket gopher. (Wallace and Heavly, p. 116).

Woodhouse also collected two amphibious species. He found *A. tigrinum nebulosum*, a subspecies of the tiger salamander, to be abundant. A dark brown toad with prominent cranial crests was recognized as unique in 1858 by Charles F. Girard, who named it for Woodhouse, *Bufo woodhousei* (Woodhouse's toad). He identified at least seventeen species of birds at the spring, but took few specimens. An exception was the hepatic tanager (*Piranga flava*), which turned out to be the first example collected in the United States. (Ibid., p. 116).



## Climate and Hydrology

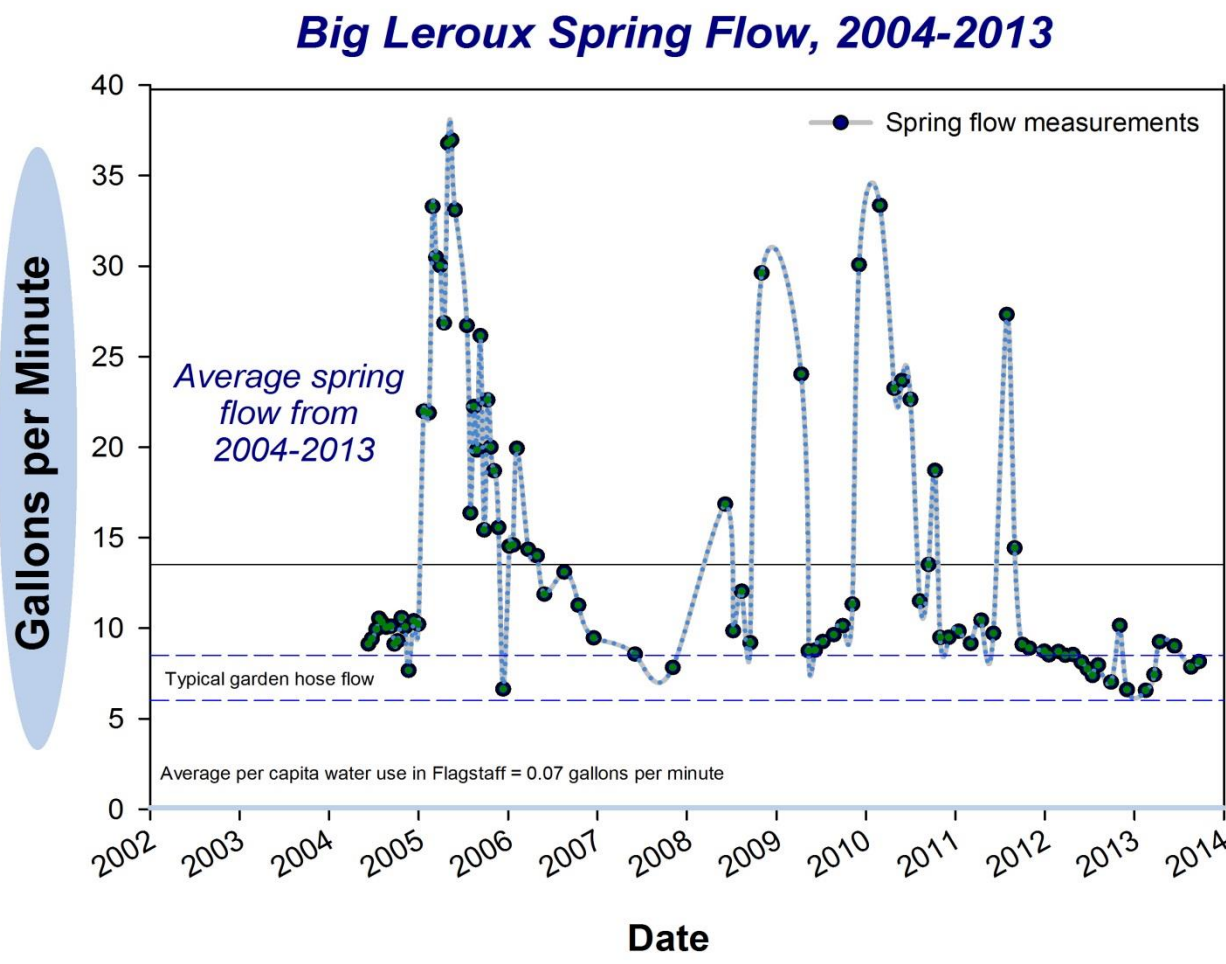
Virtually all precipitation that falls on the San Francisco Peaks infiltrates through porous or unconsolidated volcanic sediments, sublimates, or moves to the atmosphere through evapotranspiration. Infiltration at higher elevations recharges regional aquifers and local aquifers in the Inner Basin and on the flanks of the mountain.

Precipitation patterns on the San Francisco Peaks follow altitudinal and directional gradients, with greater amounts of precipitation falling at higher elevations and on the north and west sides of the mountain. Long-term precipitation data (1909 to present) are available from the Fort Valley Cooperative Weather Station (COOP ID 023160), located at 7,347 feet above sea level in Fort Valley.

Big Leroux Spring emerges from the southwest base of the San Francisco Peaks near the toe of the younger andesite of the Agassiz Peak lava flow at approximately 7,680 feet above sea level. The spring discharges on a southeast facing slope, about 100 feet above the floor of a small forested canyon. The existing spring development at Big Leroux Spring consists of a concrete spring box and a valve box with valves on both the main two-inch delivery pipe to the Hotshot Headquarters and a two-inch drain pipe with outlet.

## How Much Water Flows at Big Leroux Spring?

Prior to 2004, relatively few discharge measurements documenting the flow of Big and Little Leroux Springs were made. A measurement made in 1949 of 29 gallons per minute is the oldest known quantification of Big Leroux spring flow (Arizona Department of Water Resources). In a 1969 Forest Service Research Note E.C. Martin used spring flow data collected from Little Leroux Spring during 1947-1950 and 1963-1966 to examine the relationship between spring flow and precipitation (Martin, 1969). These data are not available. In the report Martin states occasional discharge measurements were also made at Big Leroux Spring. These measurements also are not presented, but flow of 28 gallons per minute was estimated. Several discharge measurements, ranging from 15 to 30 gallons per minute, were made at Big Leroux Spring in 1987 for the purpose of quantifying USFS water rights.



During a 2003-2004 survey of springs in the Flagstaff area the Leroux Springs drew the attention of Flagstaff hydrologist Stephen Monroe as potential restoration sites, because the large volume of water flowing at the springs is among the greatest seen at any springs flowing from the San Francisco Peaks; and because of the historic significance of these springs. Water flowing from Big Leroux Spring was clearly underutilized, but the relation between amounts needed by USFS and total amount available was unknown. During the following nine years spring flow was measured at approximately monthly intervals by Monroe and others. Flows ranged between 7 and 37 gallons per minute and average measured flow for the entire period from June 2004 to August 2013 was 13.5 gallons per minute. The plant community at the spring was surveyed and other data were collected describing characteristics of the site. During this period variation in spring flow corresponded to winter precipitation, with higher spring flows closely following wetter winters. Water temperatures were constant throughout the entire period, ranging from 8.1 to 8.6 degrees Celsius.

## Bringing Flow Back to Big Leroux Spring

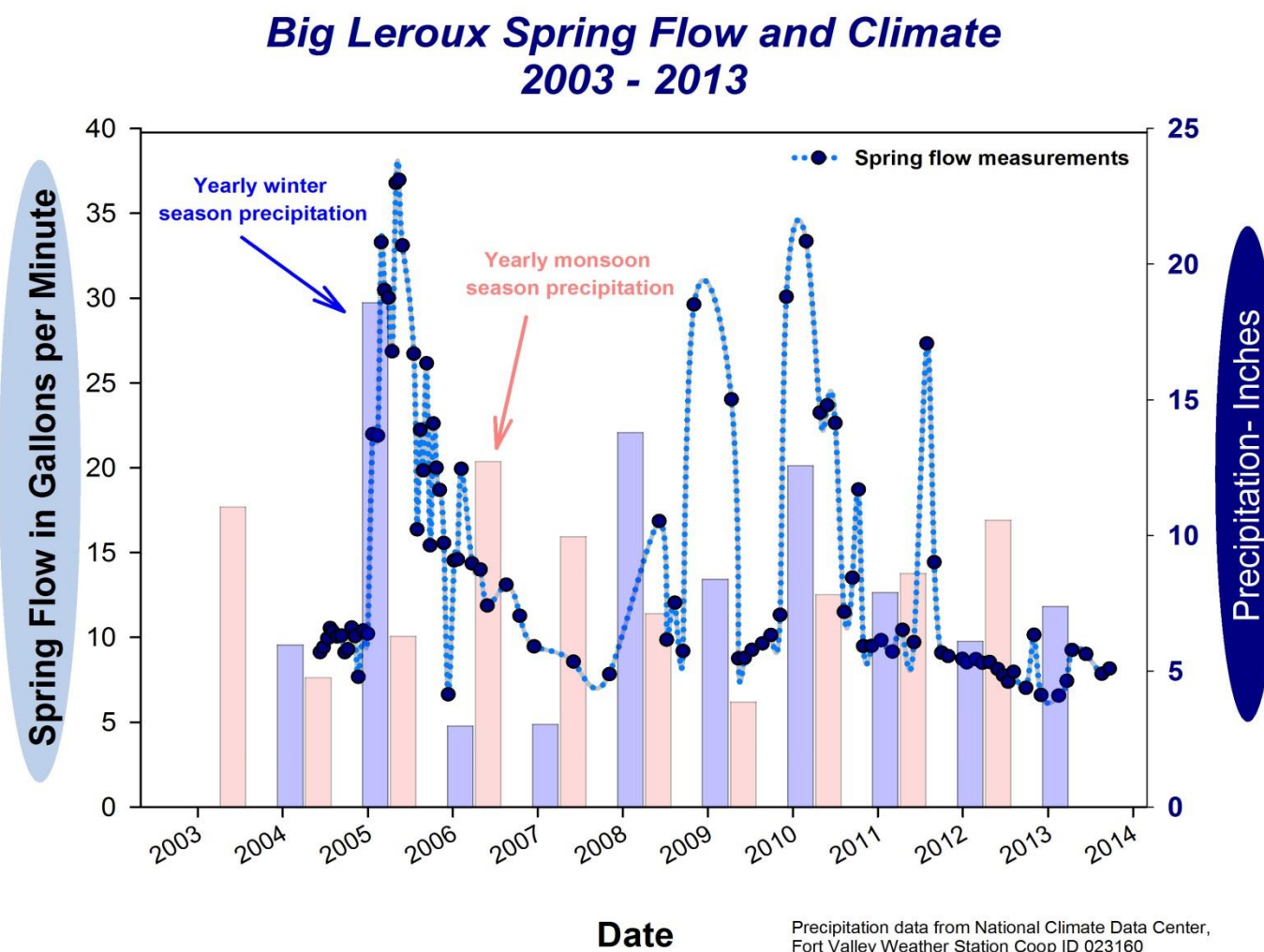
In 2011 the Coconino National Forest proposed the *Wing Mountain Fuels Reduction and Forest Health Restoration Project* which included actions intended to restore a healthy, self-sustaining riparian area around Big Leroux Spring by re-plumbing the system and releasing excess water, as well as the construction and maintenance of ungulate-deterrent fences.

Friends of the Rio de Flag submitted comments to the Wing Mountain project scoping in support of the proposed action (Monroe et al. 2012). The comments included a series of recommendations which became part of the Environmental Assessment's preferred alternative.



In early 2013, the Coconino National Forest Supervisor signed the Decision Notice and Finding of No Significant Impact for the proposed action and authorized forest health treatments for the Wing Mountain Project.

Then in late June 2013, valves in the spring box were reconfigured, releasing approximately 40% of Big Leroux Spring's output flow, launching restoration of the pre-settlement riparian zone below the spring. The remainder of the flow continues to be used for drinking water and wildlife uses.



## Adaptive Restoration

Returning surface flow to Big Leroux Spring was an important first step towards restoring a healthy self-sustaining ecosystem to the site. Because Big Leroux and most springs among the San Francisco Peaks were developed long ago little is known about what plant and animal species would thrive at these important places. Recent surveys of springs across the Coconino Plateau will provide valuable information supporting future restoration efforts. In the meantime a patient approach will be taken, allowing water to flow on the surface at Big Leroux Spring and carefully observing change.



## From the USFS *Wing Mountain Fuels Reduction and Forest Health Restoration Project Record of Decision*:

- To meet the project's purpose and need, the following activities are proposed:
- Restoration of Maxwell and Big Leroux Springs would be an initially passive approach relying on volunteers and Forest Service staff as available. Passive restoration efforts focus on reducing or eliminating the sources of degradation and allowing recovery time.
  - If after several years, monitoring suggests that passive restoration is not enough to improve native flora and fauna diversity, planting of riparian vegetation, installation of ungulate exclosure fencing, and/or limited modification of the spring discharge channel (i.e., construction of pools and other stream features to improve habitat using hand labor) would be initiated.

## Activities

To achieve the project's stated purpose the following activities are planned for the next few years.

### Infrastructure

- Construct and maintain ungulate-deterrent fences
- Removal of the existing aboveground concrete tank
- Removal of the existing barbed wire fence
- Removal of existing unused pipe
- Establish new route to spring

### Monitoring

- Spring flow
- Soil moisture
- Photopoints and time-lapse
- Semi-annual flora surveys
- Semi-annual fauna surveys – birds, bugs, other
- Develop a high-resolution base map
- Map and track changes of surface hydrologic features

### Information management and Outreach

- Website development
- Database management
- Signage

This spring restoration effort relies almost entirely on the efforts of volunteers. If you would like to be involved or would like more information email us or visit the **Friends of the Rio de Flag** website: [http://friendsoftheriodeflag.org/leroux\\_springs.html](http://friendsoftheriodeflag.org/leroux_springs.html)

## Literature cited

- Beale, E. 1858. Wagon Road from Fort Defiance to the Colorado River. House of Representatives Executive Document No. 124, 35th Congress, 1st Session, 1858.
- Cline, P. 1976. The Came to the Mountain: The Story of Flagstaff's Beginnings. Flagstaff, AZ: Northern Arizona University with Northland Press.
- Coody, R. 1988. Historic Fort Valley, Arizona: An Archaeological Survey and Historic Overview. Flagstaff, AZ: Museum of Northern Arizona.
- Martin, E.C. 1969. The Relation of Precipitation to Flow From Little Leroux Spring on the San Francisco Peaks, Arizona. Forest Service Research Note RM-129.
- Monroe, S.A., Grahame, J. and Clark, S. 2012. Big Leroux Spring (White paper submitted to Coconino National Forest on behalf of the Friends of the Rio de Flag as input to the Wing Mountain Fuels Reduction and Forest Health Restoration Project
- Olberding, S. 2007. Fort Valley Then and Now: A Look at an Arizona Settlement. Flagstaff, AZ: Fort Valley Publishing.
- Rantz, S. E. and others. 1982. Measurement and Computation of Streamflow Volume 1. Measurement of Stage and Discharge. U.S. Geological Survey, Water Supply Paper 2175.
- Sitgreaves, L. 1853. Report of an Expedition down the Zuni and Colorado Rivers in 1851. U.S. Senate Document 59, 32<sup>nd</sup> Congress, 2nd Session, 1853. (Chicago: Rio Grande Press, 1962).
- Udell, J. 1859. Journal of a Trip Across the Plains, Containing an Account of the Massacre of a Portion of His Party by the Mohave Indians in 1858. Jefferson, MO: Ashtabula Sentinal Steam Press Print. (Northern Arizona University, Cline Library Special Collections: F593 .U22 1946).
- Wallace, A. & Hevly, R. (2007). From Texas to San Diego in 1851: The Overland Journal of Dr. S. W. Woodhouse, Surgeon-Naturalist of the Sitgreaves Expedition. Lubbock, TX: Texas Tech University Press.

## Photos courtesy of Tom Bean

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